Economic and Social Commission for Asia and the Pacific

CGPRT Centre Monograph No. 45

Domestic Supply and Consumption Patterns of Coarse Grains, Pulses, Roots and Tuber Crops in Asia and the Pacific

United Nations

The CGPRT Centre

The Regional Co-ordination Centre for Research and Development of Coarse Grains, Pulses, Roots and Tuber Crops in the Humid Tropics of Asia and the Pacific (CGPRT Centre) was established in 1981 as a subsidiary body of UNESCAP.

Objectives

In co-operation with ESCAP member countries, the Centre will initiate and promote research, training and dissemination of information on socio-economic and related aspects of CGPRT crops in Asia and the Pacific. In its activities, the Centre aims to serve the needs of institutions concerned with planning, research, extension and development in relation to CGPRT crop production, marketing and use.

Programmes

In pursuit of its objectives, the Centre has two interlinked programmes to be carried out in the spirit of technical cooperation among developing countries:

1. Research and development which entails the preparation and implementation of projects and studies covering production, utilization and trade of CGPRT crops in the countries of Asia and the South Pacific.
2. Human resource development and collection, processing and dissemination of relevant information for use by researchers, policy makers and extension workers.

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(Continued on inside back cover)

Domestic Supply and Consumption Patterns of Coarse Grains, Pulses, Roots and Tuber Crops in Asia and the Pacific

"CGPRT Centre Works Towards Reducing Poverty Through Enhancing Sustainable Agriculture in Asia and the Pacific Region"

CGPRT NO. 45

Domestic Supply and Consumption Patterns of Coarse Grains, Pulses, Roots and Tuber Crops in Asia and the Pacific

Edited by
Robin Bourgeois
Yannick Balerin

CGPRT Centre
Regional Co-ordination Centre for Research and Development of Coarse Grains, Pulses, Roots and Tuber Crops in the Humid Tropics of Asia and the Pacific

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Foreword

This book is the result of continuous research collaboration between the UNESCAP Co-ordination Centre for Research and Development of Coarse Grains, Pulses, Roots and Tuber Crops in the Humid Tropics of Asia and the Pacific (UNESCAP CGPRT Centre) and the Economics, Policies and Markets Program of the Advanced Methods for Innovation in Science Department of the Centre de Coopération Internationale en Recherche Agronomique pour le Développement (Cirad-amis Ecopol).

This presentation and analysis of long-term trends and the evolution of CGPRT crops in ESCAP countries is an important input. Its comprehensive, yet detailed, coverage of crops and countries will make it a reference for researches, students and analysts involved with the development of coarse grains, pulses, roots and tuber crops in Asia and the Pacific.

Focusing on domestic supply it provides more than a mere analysis of production trends. The discussion of consumption patterns gives additional insight and understanding of the current dynamics affecting these too-often forgotten crops. Our wish is that with this book, due attention will be paid to an important and alternative source of food, feed and income for the poorest populations of the region.

Nobuyoshi Maeno
Director
CGPRT Centre

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Executive Summary

This Monograph results from co-operation between the UNESCAP CGPRT Centre in Bogor, Indonesia and Cirad-amis Ecopol, in France. It presents the situation of three groups of food crops, namely coarse grains, pulses, and root and tuber crops (CGPRT crops), in 26 countries of Asia and the Pacific, from a macro economic and aggregated viewpoint. CGPRT crops constitute a major source of food besides rice in Asia and the Pacific. These crops represent a growing alternative to rice and are also increasingly being utilized in industrial processes for the elaboration of manufactured food, animal feed and other industrial non-food uses. However, compared to rice, CGPRT crops are little known, their importance is seldom recognized and their evolution rarely analyzed in a systematic way. The generic name of "CGPRT crops" does not always ring a bell in the scientific community, however, behind it hide some key crops: maize, potato, soybean and cassava.

Analytical framework

A common framework is used to present the recent evolution and stakes of CGPRT crops. It highlights, from 1979, the evolution of some key variables such as cultivated area, yields, imports and exports, and combines them in a discussion of the ways the region as a whole and each country individually have built their domestic supply and used it for their consumption needs. This, in turn, helps in understanding some key factors and future stakes for the development of these crops in the region. For this purpose, the CGPRT crop group has been divided into sub categories and key crops. These are "Maize" and "Other coarse grains", "Soybean", "Groundnut" and "Other Pulses", "Potato", "Cassava", and "Sweet Potato".

The main sources of the data are the FAO and PNUD web sites' database and the CGPRT Centre's own country database. The 26 selected countries for this analysis correspond to the geographical mandate of the CGPRT Centre and are significant as far as CGPRT crops are concerned, either for the role these crops play in agricultural production, in trade (import and export) and/or in domestic consumption. This list includes developed countries of the region such as Australia, Japan and New Zealand for the key role they also play in terms of production, trade and/or consumption.

The results are presented successively for the three main groups and their sub-categories according to a common presentation layout. In order to better analyze the evolution observed some assumptions were made. The first one is that through the analysis of production (yield and area), imports and exports it was possible to approximate the evolution of the consumption needs for CGPRT crops in the region. Thus, the hypothesis was made that some basic socio-economic indicators would be related to the evolutions of these needs and therefore could be used to better understand the trends observed, define consumption patterns and discuss future developments. Among these expected socio-economic determinants of CGPRT crop consumption patterns special attention was given to the following:

Population growth

The population of ESCAP countries has grown by 900 million, from 2.4 billion people in 1979 to more than 3.3 billion in 1999 (+38 per cent in 20 years). This furthered the Asian and Pacific region as the most populated, with 61 per cent of the world population in 2000.

Urban population

In 1979, a quarter of the region's population lived in cities, increasing to more than 1.1 billion in 2000, around 35 per cent of the total population. The share of the rural population has since significantly lessened; only 11 countries had a rural population above 75 per cent in 1999, compared to 16 in 1979. In Australia, Japan, New Zealand and the Republic of Korea the urban population exceeds 70 per cent of the total population.

Living conditions

Based on the evolution of the Human Development Index (HDI), the 26 selected countries ranged from very low development levels (Nepal, Bangladesh, Lao People's Democratic Republic, Bhutan) to a highly developed level (New Zealand, Australia, Japan). HDI is thus assumed to be an indicator that reveals the influence of the living conditions on the development and role of CGPRT crops.

Consumption of animal proteins

The consumption of derived animal products, such as meat, milk and eggs increased significantly in Asia and the Pacific, showing a significant correlation between rural population percentage and meat consumption in kg/capita (0.73).

Agricultural and food production index

In twenty years, the food production index of the ESCAP countries progressed by +49 compared to a progression of +15 for the world. The same pattern of change occurs for the agricultural production index, which increased by +58 for the Asian and Pacific region compared to +15 for the world. These numbers attest to the extraordinary dynamism and growth of the agricultural and food sector in the region, driven by the expansion of a population becoming more and more urban, with rising standards of living.

Animal feed demand

As a result of the significant increase in the consumption of derived animal products, the livestock sector has rapidly developed. The FAO livestock index for Asia and the Pacific has more than doubled in 20 years while the world's index increased only by 10 per cent. On a regional scale, the number of cattle has increased by around 30 per cent, number of chicken heads has been multiplied by more than two, and the number of pigs has increased by 50 per cent.

Coarse grains

The coarse grains group corresponds to all the cereals with the exception of wheat and rice. Here emphasis is given to maize on one hand and to all other coarse grains together on the other. As the selected Asian and Pacific countries constitute one of the most populated regions in the world with 3.72 billion people in 2000 (more than 60 per cent of the world's population), coarse gains represent high stakes to feed the population. Asian and Pacific coarse grains respectively represent one quarter of world production and one fifth of the world's harvested

a rather stable situation. However, Asian and Pacific maize imports have considerably increased over the period (+70 per cent).

Coarse grain production has tended to increase, boosted by improved yields, reaching [illegible] million mt in 1999. Expansion of cultivated area has also contributed to the rise in maize production, but other coarse grains cultivated area shrank. Today, cultivated area in the selected countries represents around 80 million ha. The share of maize within coarse grains' harvested area is 54 per cent, while millet and sorghum have experienced significant reductions. India dominates with 65 per cent of the production of other coarse grains, essentially millet (50 per cent of total surfaces) and sorghum (46 per cent), while China, the second largest producer in the world, owns 55 per cent of the maize harvested area in the region and produces 128 million mt.

In the last 20 years, the average yield of the region has seen a significant increase for all the crops, and especially for maize (more than 1.5 t/ha in 20 years). For sorghum and millet, the yield has shown only a smooth variation. However, improvements have been more or less important and rapid depending on the country.

The region's dependence on imports of coarse grains has increased, with maize representing 54 per cent of the 44 million mt imported. Imported quantities of maize represent almost one quarter of the region's production, most of it from non-Asian and Pacific countries (USA, Argentina and South Africa). The main importers are Japan, China, and the Republic of Korea with more than 85 per cent of total imports. Imports have permitted to multiply by three the number of people consuming maize in the region, from 125 million in 1979 to 381 million in 2000. The trend shows an increasing dependence on imports. In order to satisfy local needs many countries have imported maize, taking advantage of steadily declining international prices. Usually, low costs of maize imports are linked to fully open markets in countries where there is no or little production but high demand (Japan, Republic of Korea, Malaysia, Viet Nam, Indonesia, Fiji Islands, Bangladesh). All together, the majority of countries have rather free maize markets with limited protection.

Coarse grain exports have been irregular since 1979: 10 million mt on average for the period, with a maximum of 18 million mt in 1985 and a minimum of 4 million mt in 1995. Three countries, China, Australia and Thailand, are the biggest exporters with 95 per cent of total exports and maize represents 57 per cent of total coarse grain exports. The destination of maize exports is predominantly (60 per cent) to other Asian and Pacific countries.

As a result, the trend in coarse grain trade shows that i) more and more countries have become exporters and/or importers, even though trade is still dominated in volume by only a few actors, ii) imported quantities have considerably increased, and iii) the growth rate of the difference between imports and exports is mostly positive, especially regarding maize, which means that the deficit of the trade balance is steadily increasing.

The domestic supply of coarse grains has increased regularly to 240 million mt in 1999, a growth of more than 50 per cent. Domestic supply was mostly influenced by the production level and thus followed the same trend. The increase in domestic supply is due to maize with 192 million mt in 1999. Conversely, sorghum, with a decrease of 10 million mt, represents most of the decline in other coarse grains' domestic supply. China contributes almost two thirds of the region's domestic supply.

The development of livestock in Asia and the Pacific has led to an increase in the demand for animal feed. Maize used for animal feed within domestic supply has increased from 54 million mt in 1980 to 113 million mt in 1999. On a national scale, many correlations between the level of domestic supply of maize and the size of the livestock population can be noticed. Correlations have been found for instance between maize domestic supply and respectively: pig head numbers in China, chicken head numbers in Indonesia, and cattle heads in Viet Nam.

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In 1979, a quarter of the region's population lived in cities, increasing to more than 1.1 billion in 2000, around 35 per cent of the total population. The share of the rural population has since significantly lessened; only 11 countries had a rural population above 75 per cent in 1999, compared to 16 in 1979. In Australia, Japan, New Zealand and the Republic of Korea the urban population exceeds 70 per cent of the total population.

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areas, a rather stable situation. However, Asian and Pacific maize imports have considerably increased over the period (+70 per cent).

Coarse grain production has tended to increase, boosted by improved yields, reaching 187 million mt in 1999. Expansion of cultivated area has also contributed to the rise in maize production, but other coarse grains cultivated area shrank. Today, cultivated area in the selected countries represents around 80 million ha. The share of maize within coarse grains' harvested area is 54 per cent, while millet and sorghum have experienced significant reductions. India dominates with 65 per cent of the production of other coarse grains, essentially millet (50 per cent of total surfaces) and sorghum (46 per cent), while China, the second largest producer in the world, owns 55 per cent of the maize harvested area in the region and produces 128 million mt.

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Both for maize and other coarse grains, the general tendency was a slow but regular increase in the size of the share used for animal feed within domestic supply. In parallel, the share used for human food decreased, while manufactured coarse grains' share has increased steadily since 1985. The general trend shows that the portion of maize used for animal feed was more significant in countries with a large urban population, which are also those with higher consumption of derived animal products.

The increasing consumption of coarse grains for human food concerned mainly maize (for oil) and barley (for malt). Human consumption of maize oil has increased regularly during the last twenty years. Regional production has grown from 1980 to 1999 by 113 per cent, reaching around 215 thousand mt. The main consumers of maize oil are both producing countries (Japan, Australia, New Zealand, Republic of Korea, Democratic People's Republic of Korea, the Philippines, China), and importing countries (Malaysia, Fiji Islands). All of these nine countries have in common a significant urban population and the highest HDI values. A coefficient of correlation above 0.8 links, in all the main producing countries, maize oil production and rural population, and Japan, Australia, New Zealand, Republic of Korea, Fiji Islands, the Philippines and Malaysia all have a value of HDI above 0.7.

Five countries, namely Japan, the Philippines, Republic of Korea, Australia and China represent more than 90 per cent of the quantity of barley that was processed throughout the period. These countries also had an HDI value above 0.72 in 2000.

Thus, three patterns can be identified. The first one concerns countries where domestic supply is used for processed food and for animal feed requirements: Japan, Republic of Korea, Australia and New Zealand. It corresponds to high income per capita and a significant urban population, i.e. developed countries. Access to markets is easy, and the consumption pattern is mostly oriented to processed food for human consumption. These are importing countries and sometimes exporters of processed maize food.

In the second pattern, domestic supply is used for human consumption: Bangladesh, PNG, Pakistan, Nepal, Cambodia and Lao People's Democratic Republic. It corresponds to countries with a low HDI and limited access or resources to play on the world market. They have a dominant rural population (more than 75 per cent). Coarse grains are not used for animal feed and seldom processed. These countries are usually self sufficient, and are increasing both their production and harvested area.

Finally, an intermediate pattern concerns India, Indonesia, and the Philippines. These countries have reached a level of production sufficient to partially export. Their rural population is decreasing and the HDI is improving.

The prospects for coarse grain demand in Asia and the Pacific are positive and will be driven essentially by the demand for feed and processed food by the following factors:

- Natural increases in the population combined with progressive urbanisation placing demand on processed food, and consequently generating–directly (consumption of processed food) or indirectly (production of meat and derived products) – an increase in maize/coarse grain needs (see relation between HDI and rural population below).
- Access to markets will develop or improve for all countries in the region, favouring trade exchange. More significant importers and exporters may be present in the market.

Pulses

The pulse group here includes soybean, groundnut and "other pulses". With a little more than one fifth of the world surface grown with soybean, Asia and the Pacific's soybean share within world production is only 15 per cent. Imports to the region represent around one third of

the world's imports. Groundnut in the region represents around two thirds of both world production and area, a little less than one quarter of world imports and more than one third of world exports. Asian and Pacific other pulses occupies a significant position in the world, with around half of the harvested area and production regarding the said period. Trade never exceeded 10 per cent of the world exchange.

The total harvested area of pulses has increased regularly during the last 20 years, reaching 65.6 million ha in 2000. Significant increases in harvested area characterize the pulses group. However, other pulses' harvested area did not vary significantly during the last 20 years, oscillating irregularly between 32 million and 35.5 million ha. Beans and chickpeas make up more than 60 per cent of other pulses' area. Beans, pigeon peas, lentils and lupines have been expanding while minor pulses total area has shrunk almost twofold.

The harvested areas of soybean and groundnut have increased regularly, reaching 16.8 million ha and 13.4 million ha respectively in 2000. This represents an additional 7.4 million ha of soybean cultivated over the period (+78 per cent) and 1.7 million ha of groundnut (+25 per cent). Since 1992, soybean has covered a larger area than groundnut.

India and China largely dominate the production of pulses in terms of planted area. More than 67 per cent of the total pulses were harvested in India throughout the period, a stable figure, while China's harvested area has decreased twofold compared with 1979. Groundnut in India and China represents more than 86 per cent of the region's harvested area. The two countries have experienced an inverse trend, with India's groundnut area share decreasing by 6 per cent and China's increasing by 6 per cent. However, India's share remained above 60 per cent.

Around 54 per cent of the area grown with soybean is located in China, but it is declining compared with 1979 (-16 per cent of the regional share). Meanwhile, India's share of soybean harvested area increased significantly from 5.3 per cent in 1979 to around 34 per cent in 2000 (+28.6 per cent).

On a regional scale, the yield of other pulses, soybean and groundnut have experienced a noticeable increase: +19 per cent for other pulses, +38 per cent for soybean and a spectacular +82 per cent for groundnut, in 20 years. However, the situation varies widely depending on the country. Due to significant differences in the yields, the distribution of production was quite different than the one observed for harvested area. It is especially noticeable for groundnut where China, with only 25 per cent of the harvested area, equals India's production on 60 per cent of the harvested area, with 43 per cent of the region's production.

Few changes in the harvested area and increasing yields have induced only limited growth in the production of other pulses during the last 20 years, with an average of 23.5 million mt for the period and a progression of 2.8 million mt. The production of soybean has multiplied by 2.5 in 20 years, reaching in 2000 around 23.6 million mt, with a spectacular increase in the early 90's driven by the development of soybean in India. Since 1996, production has stabilized in the range of 22/24 million mt. Groundnut production was more steady but has also doubled in twenty years and reached in 1999 around 21 million mt. Groundnut production growth is mainly due to the huge yield improvements through the period, especially in China.

Exports remain limited and irregular, but imports have been very significant for soybean, a little less so for other pulses, and negligible for groundnut. Soybean regional imports increased from 6.5 million mt in 1979 to more than 16.3 million mt in 2000. On average, imported quantities of soybean represented around 56 per cent of local production.

Japan was the main importer of soybean (49 per cent), overtaken by China since 1997. Regarding groundnut, Japan imported 37 per cent of the region's imports for the period and Indonesian imports represented around 31 per cent. Since 1987, Indonesia has been the largest importer of groundnut.

The evolution of domestic supply of other pulses, soybean and groundnut on a national scale showed similar evolutions:

- An increase in the domestic supply for most of the countries.
- A decrease in the number of self-sufficient countries.
- An increase in the number of importer countries.

This situation stresses a higher dependence on international markets to fulfil the needs for domestic consumption.

Human consumption represents 76 per cent of the use of the domestic supply of other pulses, 90 per cent of the quantity of soybean domestic supply and 88 per cent of groundnut domestic supply (59 per cent is manufactured food). The consumption of other pulses decreased slowly, reaching 5.6 kg/capita in 1999, a decrease of 1.5 kg/capita compared to 1979. Oppositely, soybean and groundnut consumption (food and manufactured food) increased and in 1999 the level of consumption for the region was 10.2 kg/capita for soybean and 5.3 kg/capita for groundnut. The Democratic People's Republic of Korea and India are the largest consumers per capita of other pulses, while Japan and Republic of Korea are the main soybean consumers with Myanmar and Vanuatu the largest consumers of groundnut.

For other pulses and groundnut, no relationship was found between the consumption levels and the levels of production/trade, percentage of rural population, or HDI. For soybean, the only clear relationship between the level of production and the level of consumption of soybean relates to huge imports, a rather logical fact. No relationship was found between socio-economic indicators such as rural/urban population, level of income, etc. and the consumption of soybean as food.

No clear domestic consumption patterns among countries arise from the analysis of pulses beside the fact that China and India are the main producing and consuming countries, a fact that is strongly related to the size of the country and population. In terms of exports, China is the major actor for all pulses (with Australia for other pulses). Regional groundnut and other pulses' exports exceed regional imports (India for other pulses and Japan/Indonesia for groundnut). In the case of soybean, regional needs (Japan and China mainly) are satisfied through imports from outside the region.

Soybean oil is a special case. Only three countries, China, Japan and India process soybean into oil and together they produce 89 per cent of the region's soybean oil. Production has multiplied by 2.7 in 20 years, reaching 3.6 million mt in 2000. Exports are not very significant (less than 4 per cent of the level of production) compared to imports (more than 60 per cent), which reached 3.1 million mt in 1999.

The domestic supply of the region reached 6 million mt in 2000. Per capita and per year, Fiji Islands is the main consumer. Consumption is quite irregular from one year to another, but the trend is towards small increases.

A relationship exists between soybean oil consumption and the level of development: the smaller the rural population, the higher the consumption of oil. Excluding the Fiji Islands, the coefficient of correlation between all consumer countries and the percentage of rural population was -0.83. Thus, the HDI level and the soybean oil consumption level (kg/capita) are correlated (0.68).

Soybean has become the major strategic commodity for the region within the pulses group. Regarding the situation of some significant consumers (China, India, Indonesia, Japan), soybean consumption as food and oil will continue to increase slowly or stabilize. As the consumption in China and Japan stabilizes (with fluctuations for China), consumption in India and Indonesia becomes a key variable for the future.

Root and tuber crops

The analysis of the root and tuber crops' group focuses on three main commodities that are relevant for Asia and the Pacific: potato, sweet potato and cassava. Asian and Pacific countries provide respectively 40 per cent and 35 per cent of the world's production and harvested area of roots and tubers (1979-1999). Asian and Pacific cassava exports and sweet potato harvested area and production of the selected ESCAP countries occupy a dominant position on a world scale, while potato trade remains marginal. The evolution of the area by crop shows different situations:

- Stabilization of cassava, around 3.5- 4 million ha.
- A regular increase for potato, from 3.7 million ha to more than 5.9 million ha (+60 per cent).
- A regular decrease for sweet potato, from 10.2 million ha to 7.2 million ha (-30 per cent).

Sweet potato yields registered the highest increase (+41.5 per cent), followed by potato (+40.4 per cent) and then by cassava (+23.3 per cent). Depending upon the country, important differences can be observed. A significant number of countries experienced a decrease in their yields. Countries with the highest yield progression include more developed countries (Australia, New Zealand, and the Republic of Korea).

The total production of roots and tubers has increased by around 61 million mt in 20 years, reaching 278 million mt in 1999. As a result from contrasted harvested area evolution and increasing yields, potato production increased in the region, while sweet potato and cassava production has remained stable.

Regarding potato, China contributes 60 per cent to regional production, followed by India with 24 per cent. At the same time, China accounts for more than 90 per cent of the region's total sweet potato production. The main producers of cassava are Thailand and Indonesia, for which the share for the period is respectively around 38 per cent (18 million mt/year) and 31 per cent (15 million mt/year).

Potato imports have increased tenfold in twenty years, especially since 1985, reaching 2.5 million mt in 2000. However, imported quantities have never exceeded 3 per cent of total domestic production. Almost all of the countries imported increasing or irregular quantities (with the exception of Lao People's Democratic Republic and Myanmar). Imports of sweet potato are very limited and irregular. With an average of 3.7 million mt, cassava imports represent on average 7.5 per cent of the level of domestic production. Around one third of the countries analyzed are not importers. The others experienced irregular or increasing imported quantities. The main importers of potato and sweet potato are Japan (36 per cent and 43 per cent respectively) and China (26 per cent and 27 per cent respectively). Regarding cassava, China, the Republic of Korea and Japan represent more than 86 per cent of the region's imports.

Cassava is the only significant export crop in Asia and the Pacific for the root and tuber crops' group. Yearly exports of potato and sweet potato are irregular, representing only 0.5 per cent of domestic production and are dominated by China with respectively 40 per cent and 98 per cent of the region's exports. Conversely, cassava exports account for 43 per cent of the quantity produced in the region. However, the trend is not regular. Thailand dominates cassava trade with an 84 per cent share of the volume exported.

Regarding potato, domestic supply has shown a significant increase from 43.9 million mt in 1979 to around 95 million mt in 1999. As exports and stock changes have not been very significant relative to the level of production, domestic supply was mostly influenced by

domestic production through a combination of cultivated area expansion and increasing yields. For sweet potato, domestic supply was nearly equal to the level of production and remained stable throughout the period in spite of a reduction in cultivated area, thanks to some increases in yield. Domestic supply of cassava reached 35 million mt in 1999, which is an increase of around 27 per cent compared to the level registered in 1979. The region is a net exporter, even though, since the last decade, the difference between these exports and domestic supply is narrowing.

The percentage of importing countries increased from 25 to 33 per cent over the period. Whilst almost half of the countries were self-sufficient at the beginning of the period, only one third remained so at the end.

Root and tuber crops are mainly consumed as food. However, the level of the share and its evolution shows differences amongst the crops, especially when looking at the share of quantities used for animal feed and manufactured food.

The share used for food within domestic supply utilization regularly decreased for sweet potato and cassava, but increased for potato. The share of animal feed within domestic supply utilization increased significantly from 26 per cent to more than 50 per cent for sweet potato. However, this share did not exceed 20 per cent for potato and 10 per cent for cassava. Only potato and cassava are consumed as manufactured food. For both crops, the evolution of share has been irregular, but regarding the period as a whole, increased.

On a regional scale, the trends show a slow decrease in the consumption of cassava. Potato and sweet potato follow an opposite but related trend. Since 1988, potato has progressively substituted sweet potato in Asian and Pacific consumption patterns.

The main cassava consumers are Indonesia and Viet Nam. The main consumers of potato are developed countries, New Zealand, Australia and Japan. The evolution of the consumption level, per capita and per year, is predominantly increasing for all countries, including the main consumers. Salomon Islands and Papua New Guinea are the main consumers. In terms of evolution of consumption, almost all the countries experienced a decrease.

The trends observed in the evolution of domestic supply of root and tuber crops show a progressive substitution of sweet potato with potato, while cassava has remained stable. Food consumption habits and climatic conditions suitable for the cultivation of the different crops are the main factors influencing the situation and the evolution of the consumption levels of roots and tubers:

- The main consumers of potato include all the developed countries (Australia, New Zealand, Japan).
- The main consumers of sweet potato include countries with a low HDI value (Pacific Islands, Viet Nam, Lao People's Democratic Republic).
- No relationship/correlation can be established between HDI value, percentage of urban population, trade aspects and the level of consumption.

In consequence, two patterns can be identified. The first pattern relates to a number of countries that are still big consumers of sweet potato, but small consumers of potato. These countries, characterized by a lower level of development, are increasing their growing area of potato and maintaining or decreasing that of sweet potato. The second pattern (Japan, New Zealand and Australia) corresponds to a situation where potato consumption is high, while sweet potato consumption is low. For these countries, with a significant level of development (high HDI value) as well as a large urban population, trade (especially imports) is quite significant (at the scale of the country and/or compared to the region's trade) as well as the production of processed food.

China, India, Pakistan and Malaysia are in a transitional situation. Given the size of these countries their evolution will strongly affect the future of potato and sweet potato production and trade in the region.

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Introduction

Coarse grains, pulses, roots and tuber crops (CGPRT crops) are traditionally produced by poor households for non-market, domestic consumption in times of crisis. However, these crops show a largely under-used economic potential, both as fresh or processed products and as animal feed. The main roots and tubers (cassava, potato, sweet potato, yam) alone represent today an estimated 41 billion dollars, one quarter of the value of the main cereals. In "Roots and Tubers in the Global Food System, A vision Statement to the Year 2020", CGPRT crops are expected to undergo production growth that will maintain their economic value at 25 per cent of the global food system in developing countries, whatever the scenario. Asia is one of the major production zones for CGPRT crops among developing countries, with around 60 per cent of the coarse grain, root and tuber production and 70 per cent of pulse production. The strong growth of Asian cities creates new opportunities for CGPRT crops through the development of processing industries and the increase in animal protein intake. Animal protein production is a potential market for CGPRT crops in the frame of the strategy to substitute locally made products for imported feed. The 1997-1998 crisis has shown the sensitivity of the animal raising sector to world market fluctuations and external shocks. This substitution strategy could reduce the risks of having this situation repeat again in the future.

Located in Indonesia, the Regional Co-ordination Centre for Research and Development of Coarse Grains, Pulses, Roots and Tuber Crops in the Humid Tropics of Asia and the Pacific, (CGPRT Centre), Economic and Social Commission for Asia and the Pacific (ESCAP), United Nations, occupies a strategic position in Asia and the Pacific to offer expertise services and the facilities needed for promoting the development of the production, utilization and trade of CGPRT crops through the strengthening of national research and development activities.

Conducted by the CGPRT Centre, the MAPSuD project (MAPSuD stands for Management of Agricultural Policies for Sustainable Development) is the result of cooperation between the CGPRT Centre with the support of CIRAD and the French government. The MAPSuD project aims to strengthen the national capacity of member countries in CGPRT crop development policy formulation and analysis in the Asia-Pacific zone.

The target of this study, focusing on selected Asian and Pacific ESCAP countries and coarse grains, pulses, roots and tuber crops is to assess and compare the current situation of CGPRT crops in the Asia-Pacific region regarding harvested area, production, exports, imports, processing and domestic supply for each significant country; to study their evolution through past decades (from 1979 to 2000); to identify indicators - especially socio-economic ones – which might explain their evolution and to highlight the main issues for these crops by suggesting some scenarios of evolution for the formulation of future development policies.

In the first section, we present the analytical framework used to discuss the situation of CGPRT crops in Asia and the Pacific. Then, the next three sections are devoted to each of the three groups of crops respectively coarse grains, pulses, and roots and tuber crops. Special emphasis is given in each section on the importance of the group in Asia and the Pacific, the evolution of domestic supply, and the socio-economic determinants of this evolution. Each section concludes with an appraisal of key issues and future stakes.

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Part I
Analytical Framework

Objectives and scope of the study

The are 3 key objectives of this study as follows:

- Characterize the evolution and the current situation of CGPRT crops in relation to production, trade and consumption in Asia and the Pacific.
- Identify through relevant indicators the factors that might explain the above-mentioned evolution.
- Formulate scenarios of evolution or highlight prospects.

This Monograph presents successively the situation of three groups of food crops, namely coarse grains, pulses, and root and tuber crops. In each group, further sub divisions have been made in order to present contrasted evolutions as required. In fact, each broad group is dominated by one or a few crops whose evolution may significantly differ from the rest of the group or from other crops within the same group. Data, figures, tables and graphs take these differences into consideration and when needed, specific sub sections are devoted for specific crops or sub categories of crops.

Table 1. Crop grouping and sub-divisions

Coarse grains
Maize
Other coarse grains
Pulses
Soybean
Groundnut
Other pulses
Root and tuber crops
Cassava
Potato and sweet potato

In the coarse grains group, maize occupies a dominant position. It is thus studied separately, but comparatively, from other coarse grains. In the other coarse grains sub-category, special attention is given to sorghum, millet and barley, the most significant crops within this sub-category in Asia and the Pacific.

In the pulses group, two crops are significant, soybean and groundnut. For this reason they will be also studied separately but comparatively, along with the other pulses sub-category.

The root and tuber crops group includes mainly cassava, potato and sweet potato. Therefore, two sub-categories are analyzed separately but comparatively; cassava on one hand and potato and sweet potato together on the other. If and when required, information regarding the group of roots and tubers in general is also presented.

As displayed in Table 2, 26 countries constitute the scope of the study. These countries correspond to the geographical mandate of the CGPRT Centre (CGPRT, 1998) and are significant as far as CGPRT crops are concerned for the role these crops play in agricultural production, in trade (import and export) and/or in domestic consumption. This list also includes

developed countries such as Australia, Japan and New Zealand for the key role they play in terms of production, trade and/or consumption.

Table 2. The 26 countries included in the study

Asia			Pacific
Southeast Asia	Far East	South Asia	
Cambodia	China	Bangladesh	Australia
Indonesia	Mongolia	Bhutan	Fiji Islands
Lao People's Democratic Republic	Republic of Korea	India	New Zealand
Malaysia	Dem. People's Republic of Korea	Nepal	Papua New Guinea
The Philippines		Pakistan	Solomon Islands
Thailand	Japan	Sri Lanka	Tonga
Viet Nam			Vanuatu
Myanmar			

For each of these crops or groups of crops a common set of data and indicator are used to characterise the evolution of the economic role of these crops in Asia and the Pacific over the last twenty years, as indicated in Table 3. These indicators cover a twenty-year period between 1980 and 2000 whenever data is available. The main sources of the data are FAO and PNUD compiled from their web sites and from the CGPRT Centre's own country database and publications. The selection of these indicators is derived from a preliminary reflection concerning factors that, in Asia and the Pacific, are susceptible to affect the development of these crops. In the following section, these factors are reviewed and implications in terms of required data are discussed.

Table 3. Indicators used in characterizing the economic role of the crops under study

Crop related data	Socio-economic and other data
Harvested area	Agriculture (animal production)
Yield and production	Consumption pattern
Domestic supply	Rural/urban population
Imports	Human development index
Exports	
Domestic supply utilization	
Price	

Assumptions on key determinants

The discussion of the socio-economic determinants related to the observed evolution of the various CGPRT crops is based on the observation of specific trends in the region that are assumed to have an effect on the dynamics of the CGPRT crops. The basic assumption is that the region is progressively changing from production-driven dynamics of cultivation of CGPRT crops to demand-driven production dynamics.

It is logical to consider that as CGPRT crops are suitable for human consumption (manufactured and processed food), animal feed production and industrial non-food uses, their evolution will be strongly affected by the evolution of several factors linked to demographic and economic changes, in particular in countries where such changes have been more significant.

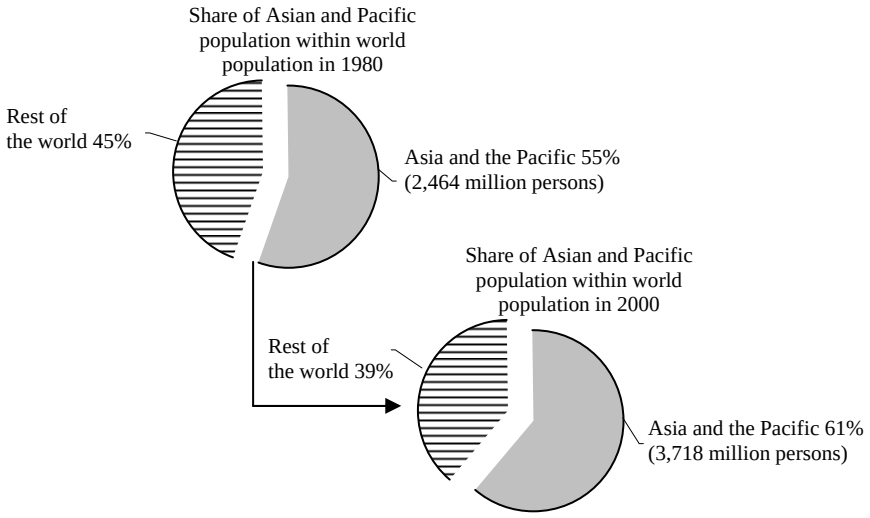
Thus, the hypothesis was made that some basic socio-economic indicators would be related to the evolutions of these needs and therefore, could be used to better understand the trends observed, define consumption patterns and discuss future developments. These expected socio-economic determinants are discussed below.

Population

During the last two decades, ESCAP countries have seen a significant growth in their population, from 2.4 billion people in 1979 to more than 3.3 billion in 1999, which is an increase of around 900 million (+38 per cent in 20 years). The average yearly growth from 1980 to 1999 was 1.6 per cent, but exceeded 2.5 per cent in some countries, especially Lao People's Democratic Republic, Vanuatu, Maldives, Cambodia and Bhutan.

This growth furthered the Asian and Pacific region as the most populated, with 61.2 per cent of the world's population in 2000, compared to 55.3 per cent in 1980 (Figure 1).

Figure 1. Share of the Asian and Pacific population within world population



Urban population

As urbanization can be related to structural changes (Regmi and Dyck, 2001) in food consumption patterns, it becomes a key variable in the analysis of the socio-economic changes in Asia and the Pacific in relation to CGPRT crop consumption. In 1979, a quarter of the region's population (around 600 million people) lived in cities, growing to more than 1.1 billion in 2000, around 35 per cent of the total population. The share of the rural population significantly lessened between 1979 and 1999. Only 11 countries had a rural population above 75 per cent in 1999, compared to 16 in 1979.

Table 4. Share of urban population of the selected ESCAP countries

Urban population	Number of countries	
	1979	1999
< 30%	3	4
30 – 50%	3	4
50 – 75%	4	7
> 75%	16	11

Table 5. Yearly urban population growth compared to rural population share

		Rural population (% of total population) – average 1979-1999			
		<30%	30 – 50%	50 – 75%	>75%
Yearly average of urban population growth during the period 1979 to 199	<1.5%	Australia, Japan, New Zealand			
	1.5 – 3.5%	Republic of Korea	Democratic People's Republic of Korea, Mongolia	Fiji Islands, Myanmar, India	Sri Lanka, Thailand, Vanuatu, Viet Nam
	3.5 – 5.5%	-	-	Malaysia, the Philippines, China, Indonesia, Maldives	Bhutan, Bangladesh, Papua New Guinea
	>5.5%	-	-	-	Cambodia, Lao People's Democratic Republic, Nepal, Solomon Islands

In Australia, Japan, New Zealand and Republic of Korea the urban population exceeds 70 per cent of the total population. Democratic People's Republic of Korea and Mongolia are in an intermediary situation as the rural population makes up between 30 per cent and 50 per cent of the total. All the other countries have a rural population above 50 per cent.

Living conditions

The Human Development Index (HDI**)** measures a country's achievements in terms of three aspects of human development: longevity, knowledge and a decent standard of living. Longevity is measured by life expectancy at birth; knowledge is measured by a combination of the adult literacy rate and the combined gross primary, secondary and tertiary enrolment ratio; and standard of living, as measured by GDP per capita (PPP US$). Regarding the value of the HDI from 1975 to 2000, significant improvements can be noticed within the Asian and Pacific region, as indicated in Table 6.

Table 6. HDI values of the selected ESCAP countries (where available)

	1975	1980	1985	1990	1995	2000	Average
Nepal	0.289	0.328	0.37	0.416	0.453	0.49	0.391
Bangladesh	0.335	0.353	0.386	0.416	0.445	0.478	0.402
Pakistan	0.345	0.372	0.404	0.442	0.473	0.499	0.423
Lao People's Democratic Republic	-	-	0.374	0.404	0.445	0.485	0.427
Papua New Guinea	0.42	0.441	0.462	0.479	0.519	0.535	0.476
India	0.407	0.434	0.473	0.511	0.545	0.577	0.491
Bhutan	-	-	-	-	-	0.494	0.494
Cambodia	-	-	-	0.501	0.531	0.543	0.525
Vanuatu	-	-	-	-	-	0.542	0.542
Myanmar	-	-	-	-	-	0.552	0.552
Indonesia	0.469	0.53	0.582	0.623	0.664	0.684	0.592
China	0.523	0.554	0.591	0.625	0.681	0.726	0.617
Solomon Islands						0.622	0.622

Continued…….

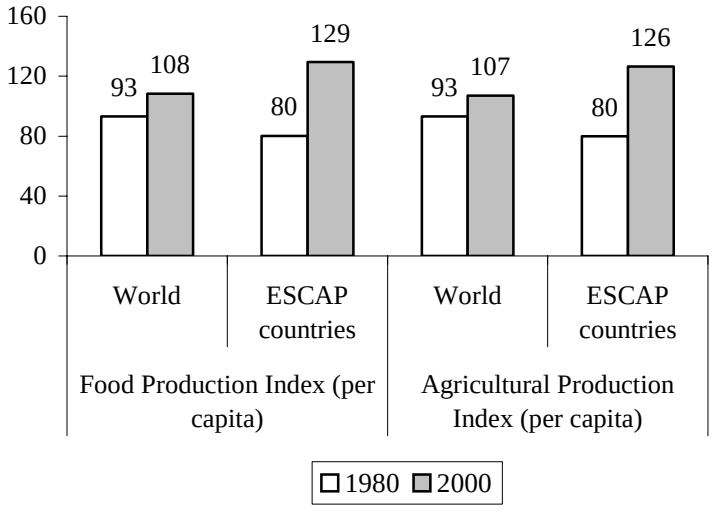
Table 6. HDI values of the selected ESCAP countries (where available), (continued)

	1975	1980	1985	1990	1995	2000	Average
Viet Nam	-	-	0.583	0.605	0.649	0.688	0.631
Mongolia	-	-	0.65	0.657	0.636	0.655	0.650
Samoa (Western)	-	-	0.65	0.666	0.689	0.715	0.680
Sri Lanka	0.616	0.65	0.676	0.697	0.719	0.741	0.683
Maldives	-	-	0.629	0.676	0.707	0.743	0.689
Thailand	0.604	0.645	0.676	0.713	0.749	0.762	0.692
The Philippines	0.652	0.684	0.688	0.716	0.733	0.754	0.705
Malaysia	0.616	0.659	0.693	0.722	0.76	0.782	0.705
Fiji Islands	0.66	0.683	0.697	0.723	0.743	0.758	0.711
Republic of Korea	0.691	0.732	0.774	0.815	0.852	0.882	0.791
New Zealand	0.849	0.855	0.866	0.875	0.902	0.917	0.877
Australia	0.844	0.861	0.873	0.888	0.927	0.939	0889
Japan	0.854	0.878	0.893	0.909	0.923	0.933	0.898

Agricultural and food production indices

In twenty years, the food production index[1] of the ESCAP countries progressed by +49 (reaching 129) compared to a progression of +15 for the world. It is consequently an increase of +61 per cent with the index value of the selected ESCAP countries passing above the world index value. The same changes occur for the agricultural production index, which increased by +58 for the Asian and Pacific region (compared to +15 for the world), reaching 126 in 2000. These numbers substantiate the extraordinary dynamism and growth of the agriculture and food sector in the region, driven by the expansion of a population becoming more and more urban, with rising standards of living.

Figure 2. FAO food and agricultural PIN net per capita (PIN 1989-1991)



[1] The FAO indices of agricultural production show the relative level of the aggregate volume of agricultural production for each year in comparison with the base period 1989-1991. They are based on the sum of price-weighted quantities of different agricultural commodities produced after resting the quantities used as seed and feed, weighted in a similar manner.

Consumption of animal proteins and feed demand

From 1979 to 2000, the consumption of derived animal products, such as meat, milk and eggs increased significantly.

Table 7 presents the growth of milk, meat and egg consumption per capita between the period 1979-1984 and 1994-1999 (average yearly consumption/capita/year). It shows an important increase in the consumption of derived animal products. Many countries show significant positive growth for all sources of animal proteins (Sri Lanka, Papua New Guinea, Viet Nam, Myanmar, Malaysia, Japan, Indonesia, India and Fiji Islands).

The consumption of animal derived products was more significant in countries that have experienced economic growth and an increasing urban population. The correlation coefficient between rural population (in per cent) and meat consumption (kg/capita) is 0.73.

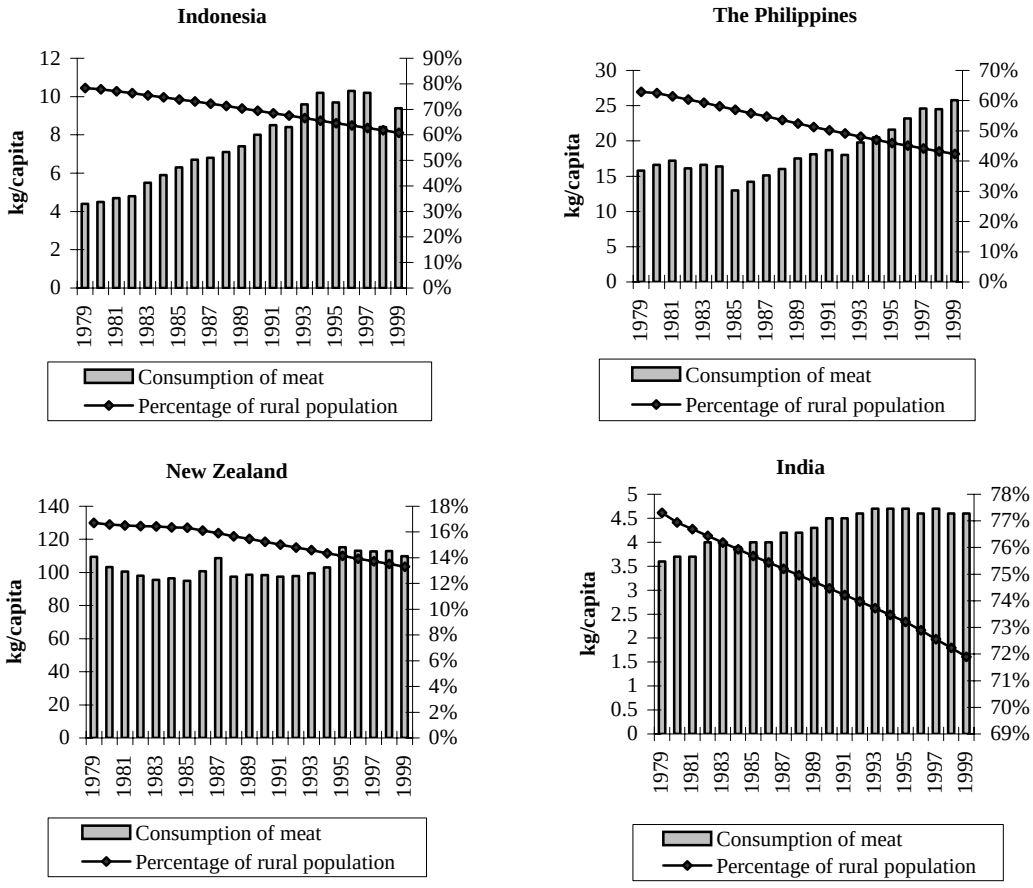
To illustrate this situation, a selected set of representative countries is displayed hereafter: Thailand (urban population above 75 per cent for the period); Indonesia (urban population between 60 and 75 per cent); the Philippines (urban population between 40 and 60 per cent); New Zealand (rural population below 40 per cent). The evolution of derived animal products was more or less significant depending on the stage of evolution of the country (consumption increases were slow for New Zealand for which share of urban population was stable), and/or on the food consumption habit of the country (case of India).

Table 7. Growth of the average yearly consumption (per capita) between the period 1979-1984 and the period 1994-1999 (per cent)

Country	Milk	Meat	Eggs
Australia	-0.1	-3.6	-45.8
Bangladesh	64.9	-15.5	54.1
Cambodia	75.8	48.3	0.0
China	-52.7	10.6	382.1
Democratic People's Republic of Korea	-11.9	7.2	-35.5
Fiji Islands	42.4	21.8	28.4
India	10.8	37.2	87.0
Indonesia	9.5	73.7	80.7
Japan	28.1	36.2	18.2
Lao People's Democratic Republic	-46.2	119.9	3.2
Malaysia	98.0	485.4	49.2
Mongolia	11.3	19.0	-81.8
Myanmar	331.8	37.4	6.3
Nepal	13.3	-4.3	-3.5
New Zealand	174.1	179.8	-35.4
Pakistan	24.3	10.9	50.0
Papua New Guinea	12.4	42.0	10.3
Republic of Korea	11.0	-14.4	41.7
Solomon Islands	434.5	44.3	-22.9
Sri Lanka	47.3	95.3	29.4
Thailand	-46.8	-43.4	44.2
The Philippines	13.3	-44.1	37.7
Vanuatu	13.6	116.5	-27.8
Viet Nam	12.5	69.7	91.4

The significant increase in the consumption of derived animal products in certain countries is also a consequence of this dynamism. As a result, an increase in the livestock population places a stronger demand on raw materials for animal feed.

Figure 3. Evolution of the percentage of rural population and the consumption of meat in 4 selected ESCAP countries from 1979 to 1999

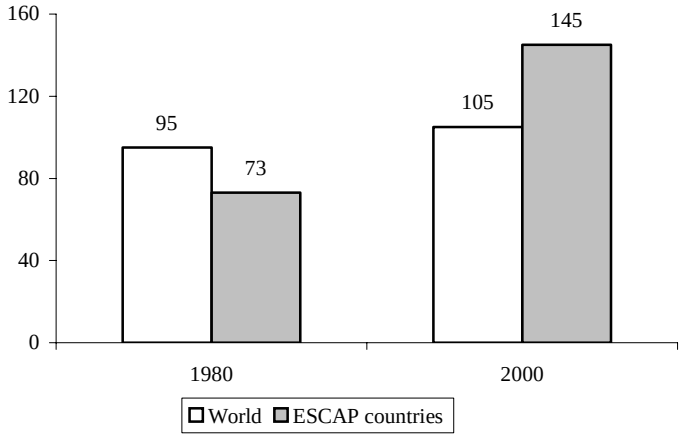


The husbandry sector has logically developed rapidly during the last 20 years to provide sufficient quantities of meat, milk and eggs for an increasing urban population. The livestock FAO index for Asia and the Pacific (net per capita PIN 89-91) has more than doubled in 20 years, while the world's index increased by only 10 per cent, as indicated in Figure 4.

Table 8. Growth rates of livestock head numbers from 1980 to 2000 (per cent)

Country	Cattle	Chicken	Pigs
China	99.2	326.7	34.4
India	17.3	127.0	1,836.0
Indonesia	87.9	559.0	192.2
The Philippines	39.3	187.9	39.7
Thailand	54.8	184.3	154.3
Viet Nam	150.9	242.5	128.7
Pakistan	47.7	289.5	
Nepal	2.8	217.7	142.2
Democratic People's Republic of Korea	-35.5	-42.2	-25.8
Total	29.40	231.0	48.1

Figure 4. FAO livestock (PIN) net per capita PIN 1989-1991



The increase in the number of heads has been spectacular. Table 8 illustrates some examples for selected countries. On a regional scale, the number of cattle has increased by around 30 per cent, the number of chickens has been multiplied by more than 2 and the number of pigs increased by 50 per cent.

Other factors

The combination of a growing population, the development of urban poles and rising standards of living do not uniformly affect, however, all of the countries in the region. It is therefore expected that specific patterns may be identified as regards the evolution of different types of CGPRT crops.

Furthermore, some other factors may also shape the dynamism of the crops and the possible changes. Climatic and ecological conditions render, for instance, some countries more suitable for the cultivation of specific crops. This in turn makes the local population more or less likely to adopt new sources of carbohydrates.

In the three following sections, the presentation of the trends in the role of the different crops and the evolution of their domestic supply both at a regional and individual country level is followed by a discussion of their related determinants.

Data requirements and utilization

In order to fulfil the objectives as indicated in Section 1 and in relation with the assumptions made in Section 2, various types of data need to be compiled and analyzed.

First, for each category of crops and for each specific crop, the following data has been gathered.

Production situation

- Evolution of harvested area (country and region).
- Evolution of yield.
- Evolution of production (country and region).
- Evolution of farmer price (country, region, crop).

Trade

- Evolution of imports (country, region, crop).
- Evolution of exports (country, region, crop).
- Evolution of domestic supply (country, region, crop).

Then, for the most significant countries a further set of data was examined.

Relation of CGPRT crops to general agriculture

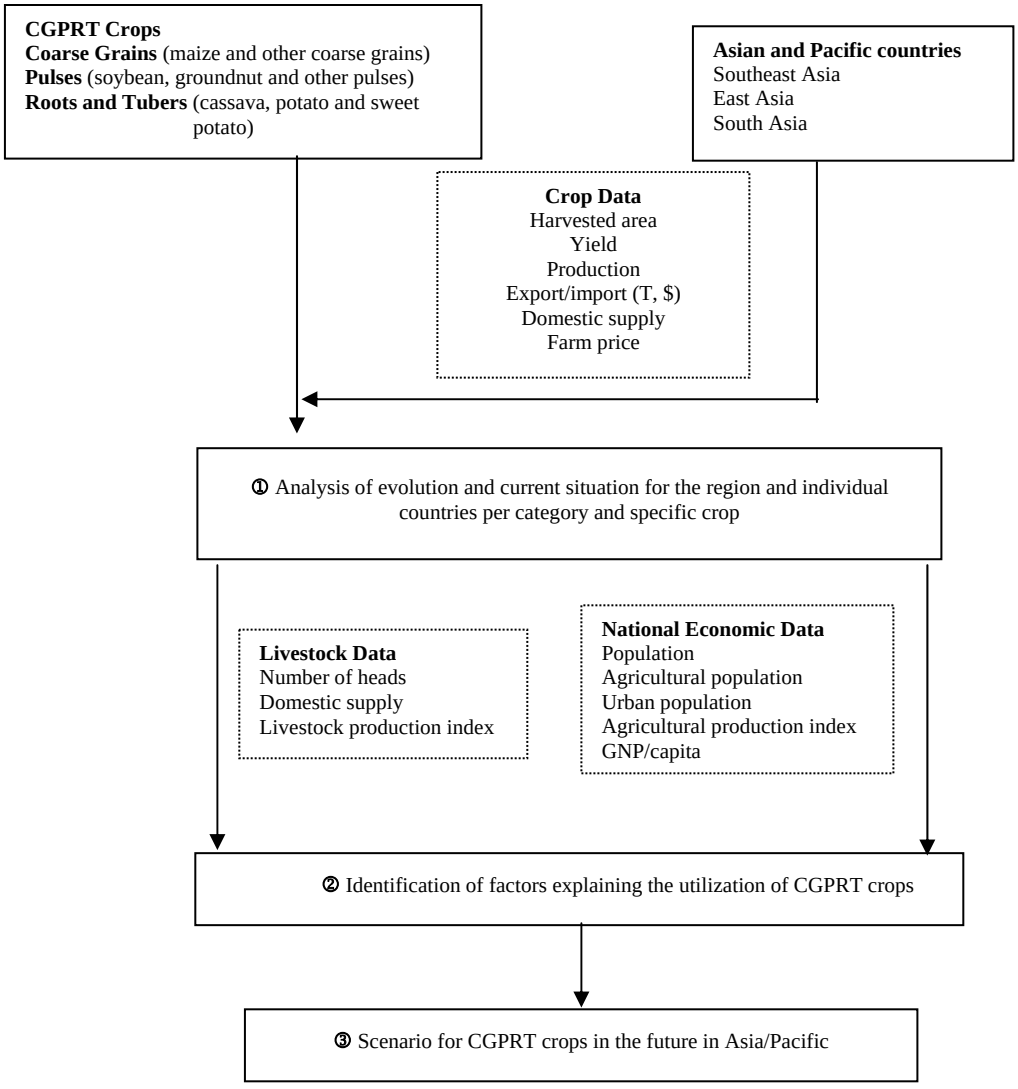
- Evolution of agricultural production index in relation with harvested area (PIN) (crops).
- Evolution of GNP (or percentage agriculture if available) in relation with harvested area (crops).
- Evolution of agricultural population in relation with domestic supply (crops).
- Evolution of urban population in relation with domestic supply (crops).

Relation of CGPRT crops to animal production

- Evolution of cattle size in relation with harvested area (crops).
- Evolution of domestic supply of meat, eggs and milk in relation with the evolution of domestic supply, imports and exports (crops).

12 *Analytical Framework*

The flow chart below synthesizes the successive steps used in order to provide assessment of CGPRT crops.



According to this framework, results are presented successively for the three main groups and their sub-categories following a common layout that includes the following items:

- Importance of the crop group.
- Evolution of domestic supply.
- Socio-economic determinants of consumption.
- Future development prospects.

Part II
Coarse Grains

Importance of coarse grains

The coarse grains' group

Among cereals[1], the coarse grains group is composed of the following crops: barley, maize, pop corn, rye, oats, millet, sorghum, buckwheat, quinoa, fonio, triticale, canary seed, mixed grains and other, less significant cereals. In short, it corresponds to all the cereals with the exception of wheat and rice.

These crops play a fundamental role in human consumption and also as animal feed because of their energy value, their suitability for processing, and their adaptability to diverse environments. The cereal products are derived either from the processing of grain through one or more mechanical or chemical operations, or from the processing of flour, meal or starch. As the selected ESCAP countries constitute one of the most populated regions in the world with 3.72 billion people in 2000 (more than 60 per cent of the world population), coarse gains represent high stakes to feed the population.

FAO define the main characteristics of the crops composing the coarse grains group as follows:

Maize is one of the main graminae produced in the world as it can be consumed for human food (grain from ear, oil produced from germ, starch extracted from the grain used for flour and bran of maize) and animal feed (silage, cake of maize which corresponds to the residue coming from the extraction of oil germ).

Sorghum is a cereal that has both food and feed uses. Sorghum is a major food grain in places where it is also used in traditional beer brewing.

Barley is a crop which tolerates poorer soils and lower temperatures better than wheat. Varieties include with husk and without (naked). It is essentially used as a livestock feed, for malt (used in brewing and distilling, and as a nutrient additive) and for preparing foods. The roasted grains are a coffee substitute.

Millet is a small-grained cereal that includes a large number of different botanical species. Originated from the domestication of wild African grasses in the Nile valley and the Sahel zone, millet was subsequently taken to China and India. It tolerates arid conditions and possesses a small, highly nutritious grain that stores well. It is used locally, both as a food and as a livestock feed. Millets are also used in traditional beer brewing and as feed for birds.

Rye is a grain that is tolerant of poor soils, high latitudes and altitudes. It is mainly used in making bread, whisky and beer. When fed to livestock, it is generally mixed with other grains.

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[1] Cereals are generally of the graminous family and, in the FAO concept, refer to crops harvested for dry grains only. Crops harvested green for forage, silage or grazing is classified as fodder crops. Also excluded are industrial crops, e.g. broom sorghum (crude organic materials nes) and sweet sorghum when grown for syrup (sugar crops nes). For international trade classifications, fresh cereals (other than sweet corn), whether or not suitable for use as fresh vegetables, are classified as cereals.

Cereals are identified according to their genus. However, when two or more genera are sown and harvested as a mixture they should be classified and reported as mixed grains.

Oats are a plant with large open, spreading panicle-bearing spikelets, used primarily in breakfast foods. It makes excellent fodder for horses. Rolled oats are obtained by crushing or rolling the whole or broken grain.

Buckwheat, quinoa, fonio, triticale, mixed grain and cereal nes are minor cereals.

For the purpose of this study, maize is considered separately and an **"Other coarse grains"** category is used for including mainly sorghum, millet and barley.

Coarse grains in the world and in Asia and the Pacific

As indicated in Table 9, Asian and Pacific coarse grains respectively represent one quarter of world production[2] and one fifth of the world's harvested areas, a rather stable situation compared with the beginning of the period. However, Asian and Pacific maize imports have considerably increased over the period (+70 per cent).

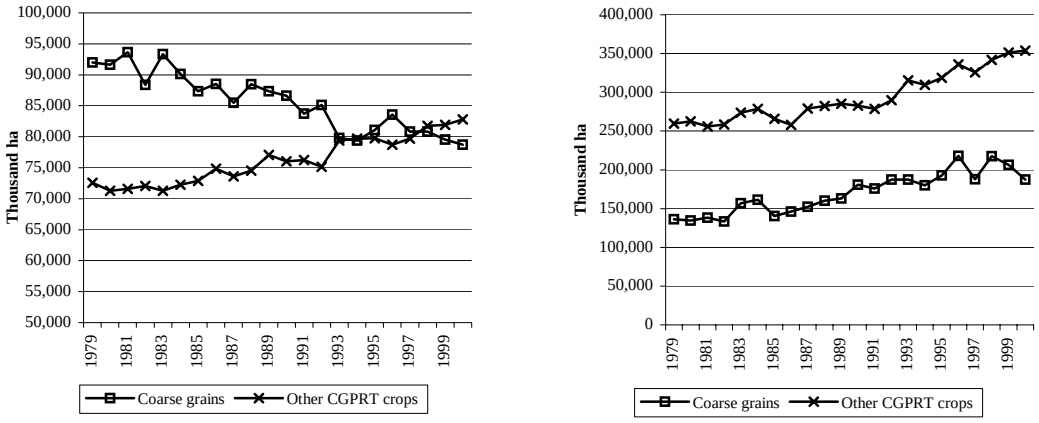
Table 9. Distribution of maize and other coarse grains (per cent)

Share of Asia and the Pacific within the world		Coarse grains (total)	Maize
Production	1979	18	19
	Average	21	24
	1999	21	24
Harvested area	1979	27	29
	Average	25	29
	1999	25	28
Imports	1979		27
	Average		43
	1999		43
Exports	1979		2
	Average		6
	1999		7

Coarse grain production followed an increasing trend similar to other CGPRT crops (Part II and III (Importance of pulses)) but evolved in an opposite way regarding harvested area, decreasing during the two last decades, indicating significant gains in yield over the last 20 years.

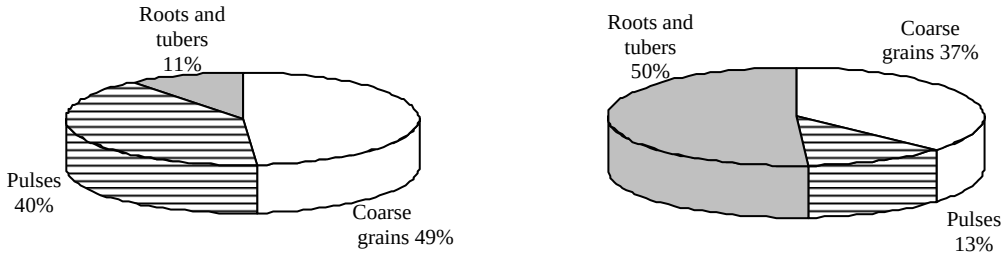
[2] Production data is reported in terms of clean, dry weight of grains (12-14 per cent moisture) in the form usually marketed. Apart from moisture content and inedible substances such as cellulose, cereal grains contain, along with traces of minerals and vitamins, carbohydrates - mainly starches - (comprising 65-75 per cent of their total weight), as well as proteins (6-12 per cent) and fat (1-5 per cent).

Figure 5. Evolution of harvested area and the production of coarse grains and other CGPRT crops, 1979-2000



In terms of share, during the period 1980-2000, coarse grains represented around 50 per cent of the total harvested area of CGPRT crops for the selected ESCAP countries and around 37 per cent of production. However, in 20 years, the share of the area planted with coarse grains within CGPRT crop harvested area decreased regularly from 56 to 49 per cent.

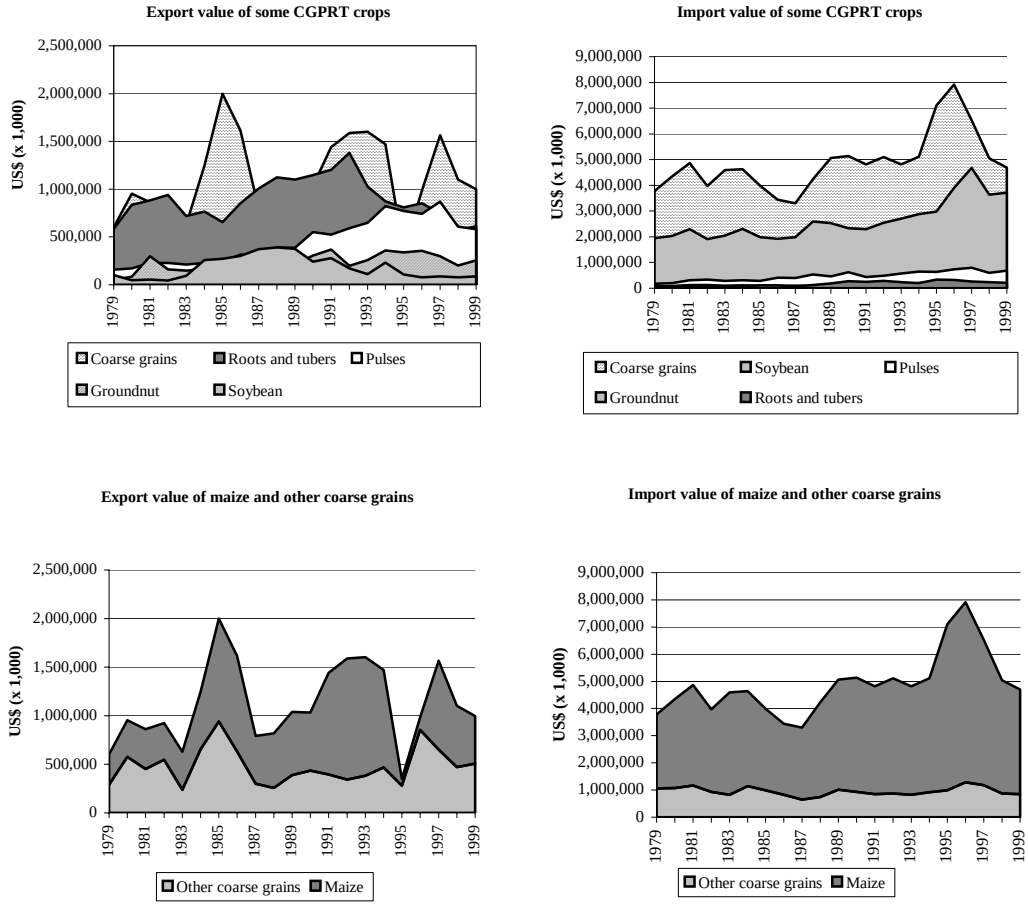
Figure 6. Distribution of the harvested area and the production of CGPRT crops in seleceted Asian and Pacific countries (average 1979-2000)



Coarse grains, mostly maize, occupy a significant position in the trade of CGPRT crops. The value of coarse grain exports is high with more than US$ 23.6 billion in 20 years, followed by roots and tubers (US$ 18.7 billion). Regarding imports, the value of maize was the most significant throughout the period, with almost US$ 102.5 billion during 20 years, before soybean (US$ 55.2 billion).

Within the coarse grains' group, maize imports represent almost half of total imports. It amounts to more than 80 per cent of the value of total coarse grain imports (around US$ 4 billion in 20 years).

Figure 7. Export and import values of some CGPRT crops, maize and other coarse grains, 1979-1999



Maize boosts domestic supply and overtakes other coarse grains

Area fluctuates, yields improve

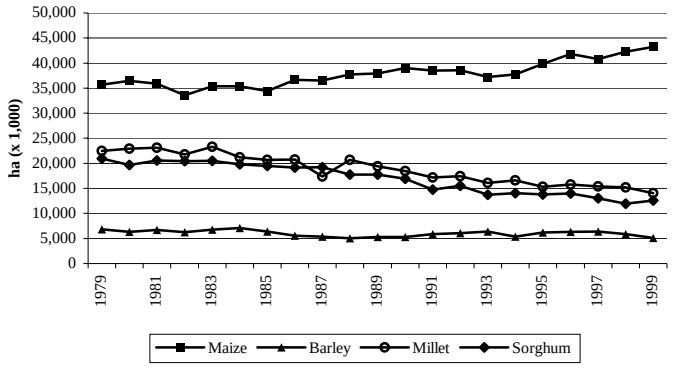
Area

The harvested area of coarse grains for the selected ESCAP countries was 79.5 million ha in 1999 but has diminished by 12.5 million ha during the last twenty years.

This decrease is explained by the reduction in harvested area of other coarse grains, especially sorghum, millet and barley, from 55 million ha (1979) to 35 million ha (1999). The harvested area for maize has also evolved but in a different way. It registered a slow but steady increase from 35.6 million mt (1979) to more than 42 million mt (1999).

Consequently, in twenty years, the position of maize within the coarse grains group has increased significantly. The maize harvested area's share within coarse grains was almost 39 per cent in 1979, but increased to 54 per cent by 1999.

Figure 8. Harvested area of maize, barley, millet and sorghum from 1979 to 1999 for the selected ESCAP countries



The evolutions vary with the countries, as can be observed in Table 10.

Table 10. Evolution of the harvested area of maize and other coarse grains, 1979-1999

Evolution of the harvested area (1979 – 1999)	No production	Stable	Increasing	Decreasing	Smooth variation	Irregular
Maize		Bhutan	China, India, Nepal, Indonesia, Pakistan, Viet Nam	The Philippines, Democratic People's Rep. of Korea, Rep. of Korea, Malaysia	Thailand, Myanmar, Australia, New Zealand, Bangladesh	Lao People's Democratic Republic, Sri Lanka, Fiji Islands,
Other coarse grains	Cambodia Indonesia, Lao People's Democratic Republic, Malaysia, Solomon Islands, Vanuatu, Viet Nam	Australia	China, India, Nepal	Rep. of Korea, Thailand, Mongolia, the Philippines		Pakistan, Bangladesh, New Zealand, Myanmar

With the exception of maize, the stabilization or the increase of harvested area remained marginal compared to decreases or irregular situations.

Figure 9. Coarse grains (without maize) harvested area

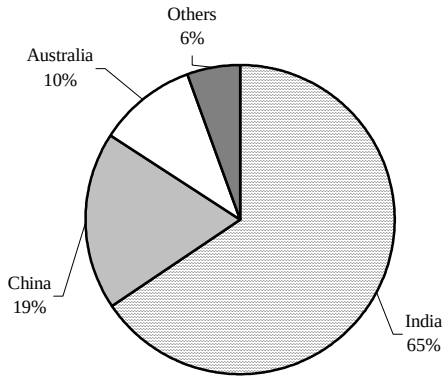
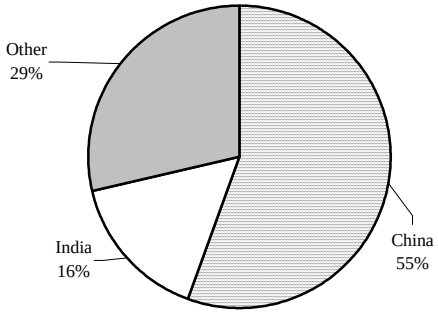


Figure 10. Maize harvested area

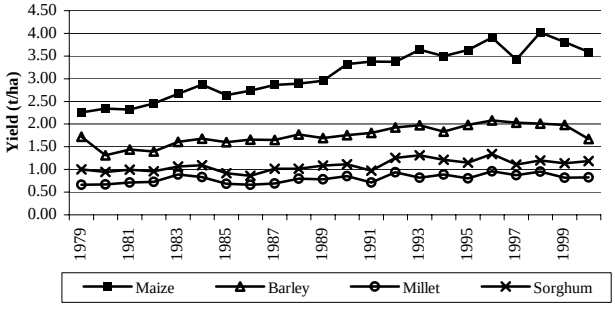


The major stakeholders are China and India within the region. India dominates with 65 per cent of the production of other coarse grains, essentially millet (50 per cent of total area) and sorghum (46 per cent), while China's maize accounts for 55 per cent of the harvested area in the region.

Yield

In 20 years, the average yield of the region has seen a significant increase for all the crops, and especially for maize (yield increased by more than 1.5 t/ha in 20 years). For sorghum and millet, yield has shown only a smooth variation. Yield of barley has registered significant improvements (the trend of the region showed a regular, but slow increase).

Figure 11. Yield of maize, barley, millet and sorghum from 1979 to 1999 for the selected ESCAP countries



Improvements have been more or less important and rapid depending upon the country. Huge discrepancies exist within the countries and some countries even evolved in a different way than the way observed for the region, as displayed in Table 11.

Table 11. Average yield for 1997-2001 compared to 1979-1984

Average yield period 1997 to 2001 – Average yield period 1979 to 1984 (t/ha)	Decreasing	Yield gain ton/ha			
		< 0.5	[0.5; 1]	[1; 2]	> 2
Maize	Democratic People's Rep. of Korea, (Maldives unchanged)	Pakistan, Japan, Fiji Islands, Bangladesh, Myanmar, Nepal, Bhutan, Vanuatu, Rep. of Korea, Sri Lanka	Malaysia, Cambodia, Indonesia, the Philippines, India	New Zealand, China, Viet Nam, Thailand, Lao People's Democratic Republic	Papua New Guinea, Australia
Sorghum	Sri Lanka, Democratic People's Rep. of Korea, the Philippines, (Maldives unchanged)	India, Pakistan	Australia, China, Rep. of Korea, Thailand	Papua New Guinea, Bangladesh	Fiji Islands
Millet	Pakistan, Democratic People's Rep. of Korea, Rep. of Korea, Japan	Australia, India, China, Nepal, Bhutan, Sri Lanka, Myanmar, Bangladesh	Maldives		
Barley	China, Mongolia, Bhutan, Democratic People's Rep. of Korea, (Myanmar unchanged)	Japan, Pakistan, Rep. of Korea, Nepal, Bangladesh	India, Thailand, Australia		New Zealand

Production

Due to yield increases, especially maize yield, and despite a decrease in harvested area, especially for other coarse grains, total production of coarse grains increased and reached more than 187 million mt in 2000, a 39 per cent increase in 20 years.

China, which is, after the United States, the largest producer of maize in the world, saw its production rise to 128.3 million mt in 1999 and represent for the whole period 78 per cent of the ESCAP countries average production (Figure 12).

Figure 12. Production of maize in the selected ESCAP countries from 1979 to 1999

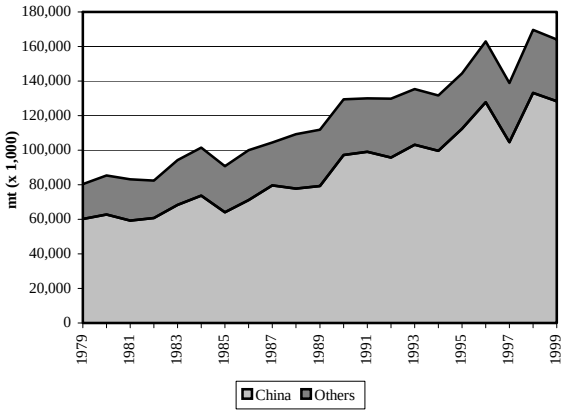
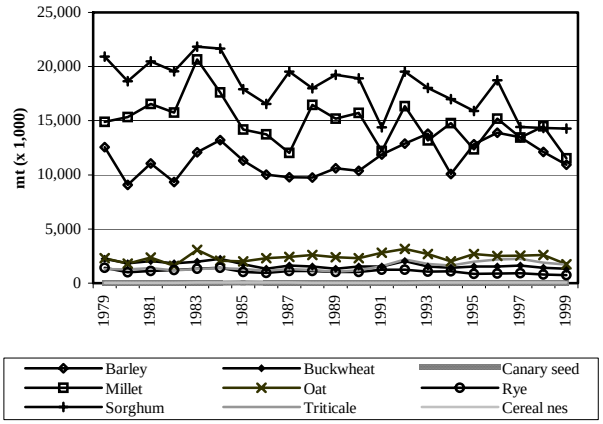


Figure 13. Production of coarse grains (excluding maize) in the selected ESCAP countries



The increase in production was impressive (it has almost doubled in 20 years for the region, reaching 164 million mt in 2000), when contrasted with the situation of the other coarse grains. After growth between 1979 and 1992, sorghum and millet production dropped significantly (with the exception of 1996) from around 42 million mt (1992) to around 25 million mt (1999).

Table 12. Evolution of production of maize and sorghum, 1979-1999

Evolution of the production (1979 – 1999)	Not producer	Stable	Increasing	Decreasing	Smooth variation	Irregular
Maize		New Zealand, Vanuatu	China, India, Indonesia, Pakistan, Nepal, Viet Nam, Myanmar, Australia, Lao People's Democratic Republic, Malaysia, Papua New Guinea	Democratic People's Rep. of Korea, Rep. of Korea, Japan		Thailand, Bangladesh, Fiji Islands, Cambodia
Sorghum	Cambodia, Indonesia, Lao People's Democratic Republic, Malaysia, Solomon Islands, Vanuatu, Viet Nam	Pakistan	China	Thailand		India, Australia

Continued …..

Table 12. Evolution of production of maize and sorghum, 1979-1999 (continued)

Evolution of the production (1979 – 1999)	Not producer	Stable	Increasing	Decreasing	Smooth variation	Irregular
Millet	Cambodia, Indonesia, Lao People's Democratic Republic, Malaysia, Solomon Islands, Vanuatu, Viet Nam	Bhutan	Nepal, Myanmar	China, Bangladesh, Democratic People's Rep. of Korea, Sri Lanka, Rep. of Korea	Japan	India, Pakistan, Australia, Maldives
Barley	Cambodia, Indonesia, Lao People's Democratic Republic, Malaysia, Solomon Islands, Vanuatu, Viet Nam	Bhutan	China, Nepal, Thailand	India, Rep. of Korea, Japan, Bangladesh	Pakistan, New Zealand	Australia, Mongolia

Accrued dependence towards outer Asia and the Pacific

Imports

Imports of coarse grains to the selected ESCAP countries reached 44.5 million mt in 1999, which is an increase of 14.4 million mt in 20 years. This increase has been regular and the imported quantities represent every year almost one fifth of local production. Maize represented 54 per cent of imported coarse grain quantities for the period and more than 80 per cent of the value of imports.

Maize imports for the region reached 34 million mt in 1999: an increase of 65 per cent compared with 1980, with an average of 28 million mt per year from 1980-1998 (Appendix 2). The quantities imported (1980-1998) represent almost one quarter of the region's production on average for the period. Only a little more than 12 per cent (3.5 million mt) of the imports came from the selected ESCAP countries, while 87 per cent (25 million mt) came predominantly from USA, Argentina and South Africa. The main importers were Japan, China, and Republic of Korea (more than 85 per cent of imports on average for the period).

Imports of other coarse grains oscillated between 7 million mt (1981) and 11 million mt (1999), with an average of 9 million mt yearly. The share of imports compared to the level of production, increased regularly from 13.6 per cent in 1981 to almost 25 per cent in 1999. Imports of sorghum decreased regularly (from 6 million mt in 1979 to less than 2.5 million mt in 1999), whereas imported quantities of barley grew twofold, reaching around 6 million mt in 1999. Millet was not a marketed commodity. Japanese imports represented 72 per cent of all imports within the region for the period and China became the second largest importer (share evolving from 13 per cent in 1979 to 28 per cent in 1999).

Figure 14. Imports of maize, barley, millet and sorghum from 1979 to 1999 for the selected ESCAP countries

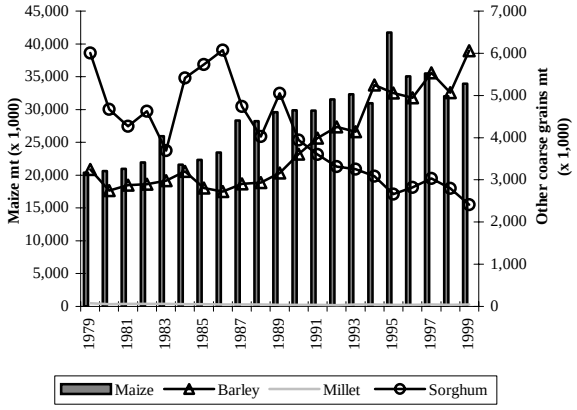


Table 13. Evolution of maize and other coarse grain imports, 1979-1999

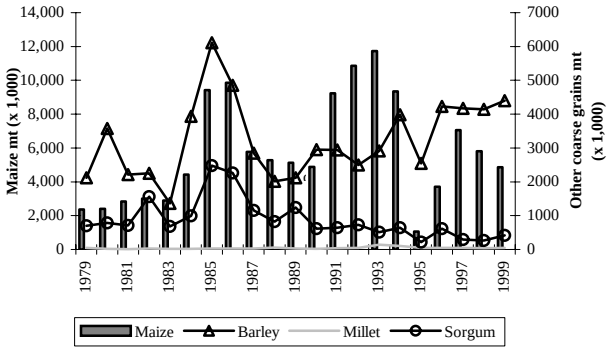
Evolution of imports (1979 – 1999)	None	Increasing	Decreasing	Irregular
Maize	Myanmar, Vanuatu (Maldives)	Japan, Rep. of Korea, China, Malaysia, Viet Nam, Bangladesh	Fiji Islands	Democratic People's Rep. of Korea, the Philippines, Indonesia, Thailand, India, New Zealand, Pakistan, Papua New Guinea, Australia, Nepal, Lao People's Democratic Republic, Sri Lanka
Other coarse grains	Maldives	China, Thailand, Malaysia, the Philippines, Fiji Islands, Viet Nam, Lao People's Democratic Republic, Cambodia	Japan, Maldives, Mongolia	Rep. of Korea, Bangladesh, Indonesia, Papua New Guinea, India, New Zealand, Australia, Sri Lanka, Democratic People's Rep. of Korea, Nepal

Exports

Exports of coarse grains from the selected ESCAP countries have been irregular since 1979: 10 million mt on average for the period, with a maximum of 18 million mt in 1985 and a minimum of 4 million mt in 1995. Three countries, China, Australia and Thailand, were the biggest exporters with a share of total exports of 42 per cent, 38.5 per cent and 15 per cent respectively, for the period.

For some periods (1979-1982; 1995-1996; 1999), exports of other coarse grains were more significant than maize exports. However, considering the period as a whole, exports of maize represented 57 per cent of total coarse grain exports.

Figure 15. Exports of maize, barley, millet and sorghum from 1979 to 1999 for the selected ESCAP countries



Around 5.8 million mt of maize were exported yearly until 1999, 5 per cent of the region's production. Thai and Chinese exports represented 95 per cent of the total region's exports regarding the whole period. During 1980-1998, the destination of maize exports was predominantly (around 60 per cent) to other ESCAP countries.

Exports of other coarse grains were also quite irregular, with a peak in 1984-1986 at 9 million mt. On average for the period, 4.5 million mt were exported yearly, which was around 9 per cent of the level of production. The main exporter was Australia with more than 85 per cent of the exported quantities for the region over the period.

Depending upon the country, different situations have been observed. Irregular export situations were the most frequent.

Table 14. Evolution of production of maize and other grains exports, 1979-1999

Evolution of exports (1979 – 1999)	None	Increasing	Decreasing	Irregular
Maize	Papua New Guinea, Lao People's Democratic Republic, Fiji Islands, Vanuatu	Myanmar, Rep. of Korea, Malaysia, Japan	Thailand, Nepal	Democratic People's Rep. of Korea, Australia, Indonesia, China, India, Pakistan, Viet Nam, Cambodia, the Philippines
Other coarse grains	Lao People's Democratic Republic, Maldives, Papua New Guinea, Viet Nam, Bangladesh	Australia	Pakistan, Indonesia, Sri Lanka, New Zealand, Thailand	Cambodia, Democratic People's Rep. of Korea, Mongolia, Nepal, Vanuatu, the Philippines, Fiji Islands, Malaysia, Rep. of Korea, Japan, India, China

Trade

During the last twenty years, more and more countries have become exporters and/or importers. However, trade was still dominated in volume by a few actors. As a matter of fact, in 1999, eight new importers (six for maize and two for other coarse grains) and 12 new exporters (four for maize and eight for other coarse grains) were registered compared to 1979.

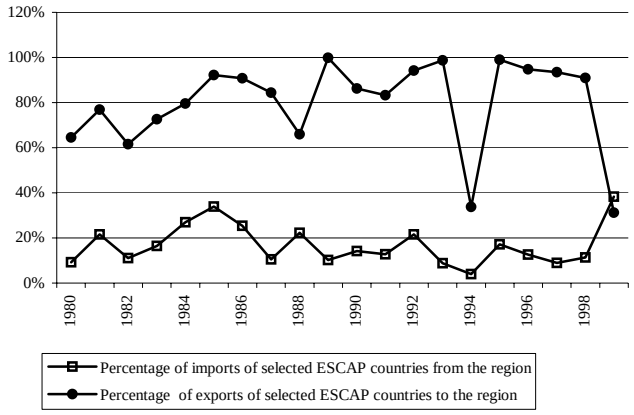
Not only have imports considerably increased, the growth rate of the difference between imports and exports is primarily positive, especially regarding maize, which means that the deficit of the trade balance is steadily increasing.

Table 15. Imports/exports and the deficit growth for maize and other coarse grains, 1980-1998

		1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Maize	Import – Export (mt)	20,361,697	20,618,697	20,988,372	21,922,561	25,914,576	21,609,445	22,313,752	23,432,779	28,329,798	28,241,729
	Growth rate of the difference	13.1%	1.3%	1.8%	4.5%	18.2%	-16.6%	3.3%	5.0%	20.9%	-0.3%
		1990	1991	1992	1993	1994	1995	1996	1997	1998	
	Import – Export (mt)	29,599,537	29,898,292	29,839,239	31,522,999	32,333,721	30,976,086	41,737,198	35,043,873	35,478,646	
	Growth rate of the difference	-4.8%	1.0%	-0.2%	5.6%	2.6%	-4.2%	34.7%	-16.0%	1.2%	
		1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Other coarse grains	Import – Export (mt)	7,822,714	7,493,229	7,878,571	7,297,129	9,589,943	9,243,138	9,408,140	8,375,933	7,735,333	8,883,813
	Growth rate of the difference	-20.0%	-4.2%	5.1%	-7.4%	31.4%	-3.6%	1.8%	-11.0%	-7.6%	14.8%
		1990	1991	1992	1993	1994	1995	1996	1997	1998	
	Import – Export (mt)	8,454,147	8,367,178	8,379,923	8,082,387	6,155,160	10,071,761	9,724,519	9,501,611	9,248,492	
	Growth rate of the difference	-4.8%	-1.0%	0.2%	-3.6%	13.3%	10.0%	-3.4%	-2.3%	-2.7%	

Regarding the origins of imports and destination of exports, significant variations between the year and differences amongst crops can be noticed.

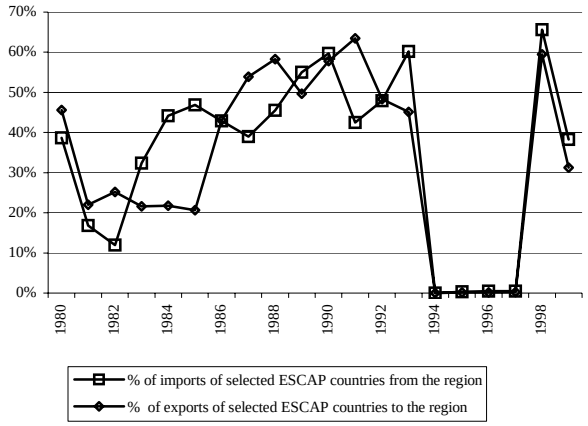
Figure 16. Trade of sorghum within the selected ESCAP region



For sorghum, only one fifth (18 per cent) of the imports came from ESCAP countries, but the destination of 75 per cent of the exports was the Asian and Pacific region.

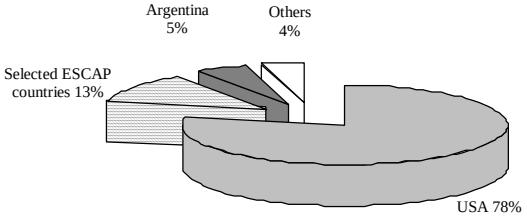
Around 40 per cent of the imports of barley came from the region, but less than 32 per cent were exported to countries within the region.

Figure 17. Trade of barley within the selected ESCAP countries



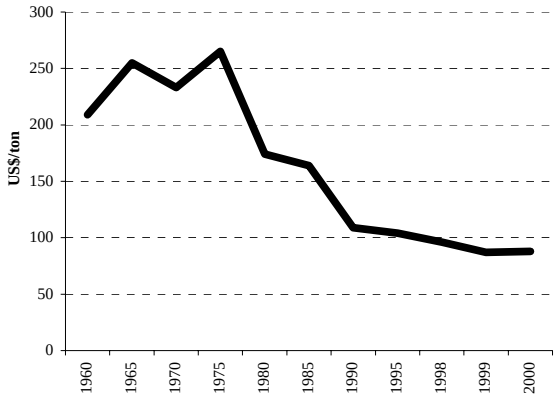
The United States supplied 78 per cent of maize imported by the selected ESCAP countries (22 million mt), followed by a group of Asian and Pacific countries (12.5 per cent) and Argentina (5.3 per cent). Around 60 per cent of the exports from the selected countries were to countries inside the region.

Figure 18. Distribution of maize imports by origin



International prices of coarse grains have been decreasing for several years. In the case of maize, since 1960 the global trend in maize prices on the international market shows a decrease from 255 US$/ton in 1965 (maize US, FOB US Gulf ports) to 88 US$/ton in 2000.

Figure 19. World market price of maize from 1960 to 2000 (maize US N°2n Yellow, FOB US Gulf ports)

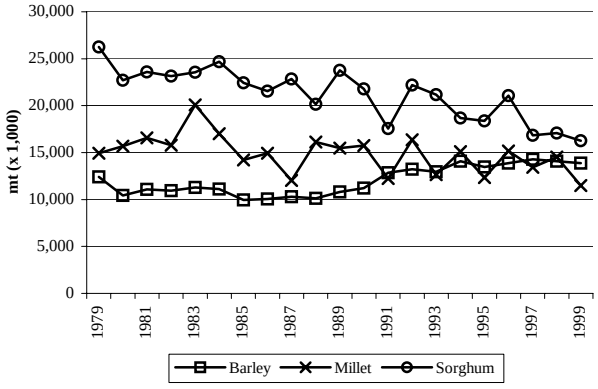


Domestic supply

From 157 million mt in 1979, yearly domestic supply of coarse grains increased regularly to 241.5 million mt in 1999, a growth of more than 50 per cent. Domestic supply was mostly influenced by the production level and thus followed the same trend. However, due to insufficient domestic production to fulfil the local needs of the region, imports have increased significantly with, comparatively, only a small variation in exports.

As indicated by Figure 20, sorghum is responsible for most of the decline in other coarse grains' domestic supply (sorghum's domestic supply registered a decrease of 10 million mt). With outstanding significant imports, this diminution of production slowly reduced the domestic supply of the region from 60.8 million mt in 1979 to 49 million mt in 1999.

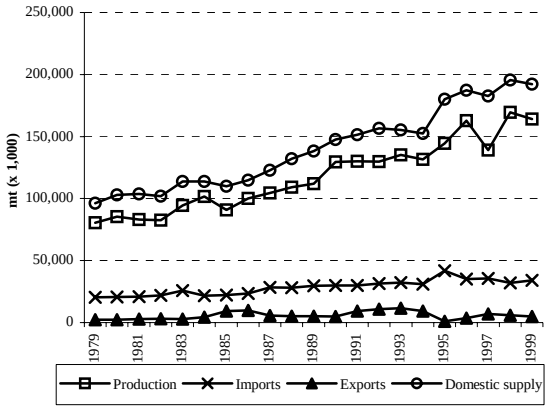
Figure 20. The domestic supply of barley, millet and sorghum from 1979 to 1999 for the selected ESCAP countries



The domestic supply of maize in the region has doubled in 20 years, reaching 192.3 million mt in 2000 (average for the period is 140.6 million mt).

China represented almost two thirds of the region's domestic supply throughout the period.

Figure 21. The domestic supply of maize (and main components) from 1979 to 1999 for the selected ESCAP countries



Imports

In order to satisfy local needs, countries have the possibility to produce, to import or to combine production and importation.

The cost of imports (US$ per ton) vary widely from one country to another. Among factors explaining these variations are: current economic policy on coarse grains, access and infrastructure. High cost of imports may be related either to protection through tariffs, or to difficulty in access.

Table 16. Cost of imports to selected ESCAP countries

	Cost of 1mt of maize imported (US$/tons. yearly average)	HDI (average value 1975, 1980, 1985, 1990, 1995, 2000)	Import (mt)/production (mt) average period (in per cent)
Maldives	2,122	0.689	784.3
Vanuatu	1,268	0.542	0.2
Australia	1,205	0.889	3.4
New Zealand	1,203	0.391	5.8
Cambodia	859	0.525	0.6
Pakistan	728	0.423	0.3
Thailand	630	0.692	2.1
Myanmar	400	0.650	0.0
Bangladesh	316	0.402	384.8
Lao People's Democratic Republic	299	0.427	0.4
Fiji Islands	253	0.711	325.3
The Philippines	252	0.705	5.0
Sri Lanka	247	0.683	127.6
Papua New Guinea	245	0.476	123.7
India	208	0.491	0.4
Viet Nam	173	0.631	2.3
Indonesia	165	0.592	5.0
Nepal	162	0.552	0.1
Malaysia	142	0.705	4,963.9
China	141	0.617	5.9
Japan	140	0.898	1,239,529.1
Republic of Korea	132	0.877	5,043.6

Low costs of maize imports are linked to fully open markets in countries where there is no/little production but a high requirement (Japan, Republic of Korea, Malaysia, Viet Nam,

Indonesia, Fiji Islands and Bangladesh). All together, the majority of countries have rather free maize markets with limited protection.

In addition, differences in price can also be explained by the quality of the imported maize.

Imports have permitted to multiply by three the number of people consuming maize in the region, from 125 million in 1979 to 381 million in 2000. Even if the situation differs from country to country, the trend shows an increasing dependence towards imports. Only three countries, Thailand, Myanmar and Australia, did not have to import to fulfil their domestic requirement.

Table 17. Number of people fed with imported maize by country

		Period		
	(million capita)	1979	Average (1979-1999)	1999
Number of people fed with imported maize	> 100	Japan	Japan	Japan, Bangladesh
	50-100	China	China	Rep. of Korea
	25-50	Malaysia, Rep. of Korea	Rep. of Korea, Bangladesh	India
[(Import - export + stock changes)*1,000] / total domestic supply per capita	1-25	India, Viet Nam, Malaysia	Malaysia, Sri Lanka Indonesia, Mongolia, India, the Philippines, Papua New Guinea, Democratic People's Rep. of Korea	Malaysia, China, Sri Lanka, Indonesia, Democratic People's Rep. of Korea, Viet Nam, Mongolia, the Philippines, Papua New Guinea
	0-1	Pakistan, the Philippines, Fiji Islands, Democratic People's Rep. of Korea, Papua New Guinea, Sri Lanka	Lao People's Democratic Republic, Maldives, Pakistan, Fiji Islands	Pakistan, Fiji Islands, Nepal, Maldives, Lao People's Democratic Republic

The calculation of domestic supply includes different components: imported quantities, exported quantities, changes in stock and the volume of production. An increasing, decreasing or stable domestic supply may hide different combinations of these elements. However, five main cases can be established as indicated below:

↔ Self-sufficiency: The local demand is supplied by local production. The concerned countries neither import nor do they export (India, Maldives, Pakistan, Vanuatu).

↯ Irregular importers: Significant level of production but occasionally forced to import to answer local demand (the Philippines).

↓ Permanent importers: All required quantities are imported because of insufficient production (Papua New Guinea, Fiji Islands, Sri Lanka) or because there is no local production (Japan, Malaysia, Republic of Korea).

⇑ Surplus exporters: When the level of production (and the level of imports) is higher than local needs some quantities are exported.

↑ Net exporters: Quantities are permanently exported (Australia). It could also, at the same time, coexist with some imports (New Zealand).

In twenty years, some countries evolved from one situation to another. Table 18 illustrates the situation observed for each country, and its evolution during the last twenty years.

Table 18. Evolution of maize and other coarse grains' domestic supply

Evolution of the domestic supply (DS) and its components	Maize domestic supply			Other coarse grains domestic supply		
	Beginning period	End period	Evolution DS	Beginning period	End period	Evolution DS
Australia	↑	↑	increasing	↑	↑	increasing
Bangladesh	↔	↓	increasing	↓	↓	irregular
Cambodia	←	↑	irregular	-	↓	irregular
China	(↔) ↓	(↔) ↓ ↑	increasing	↓ ↑	↓ ↑	decreasing
Fiji Islands	↓	↓	decreasing	↓	↓	irregular
India	↔	↔	increasing	↔	↔	stable undulating
Indonesia	↔	↓ ↑	increasing	↓ ↑	↓ ↑	increasing
Japan	↓	↓	increasing	↓	↓	decreasing
Democratic People's Rep. of Korea	↔	↓	decreasing	↔	↯	decreasing
Rep. of Korea	↓	↓	increasing	↓	↓	decreasing
Lao People's Democratic Republic	↔	↑	increasing	↓	↓	increasing
Malaysia	↓	↓	increasing	↓ ↑	↓	increasing
Maldives	↔	↔	irregular / NS	↓	-	decreasing
Myanmar	↔	↑	smooth irregular	↔	↓ ↔	irregular, increasing
Nepal	↔ (↑)	↔	increasing	↔	↔ (↯)	increasing
New Zealand	↑	↓ ↑	increasing	↑	↓	increasing
Pakistan	↔	↔	increasing	↑	↔	stable undulating
Papua New Guinea	→	→	increasing	↓	↓	irregular, increasing
The Philippines	↯	↯	increasing	↓	↓	increasing, stabilizing
Sri Lanka	↓	↓	increasing	↓ ↑	↓	irregular
Thailand	↑	↯	increasing	↓ ↑	↓	increasing
Vanuatu	↔	↔	stable	↓ ↑	↓	irregular (NS)
Viet Nam	↔	→ ↑	increasing	↓	↓	increasing

Domestic supply of maize, on a national scale, increased. However, for other coarse grains it was more irregular or in diminution. A few countries remained self sufficient throughout the whole period. At the beginning of the period, 13 countries were self sufficient for maize and four for other coarse grains. Twenty years later, only five countries maintained their maize self-sufficiency (India, Vanuatu, Maldives, Pakistan, Nepal) and three their other coarse grains self-sufficiency (India, Nepal and Myanmar).

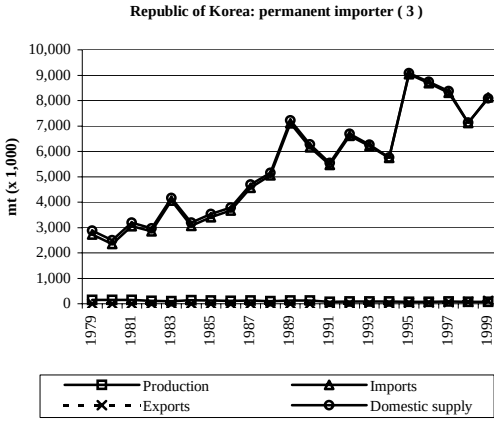
The number of permanent exporters increased from three countries (beginning of the period) to six (end of the period) for maize, but decreased from six countries to two for other coarse grains. At the beginning of the period, more than 50 per cent of the countries were showing the characteristic of being permanent importers. This number had increased slightly (especially for maize) by the end of the period. Only two countries for maize (Australia, New

Zealand) and two for other coarse grains (Australia, China) succeeded to be permanent exporters throughout the period.

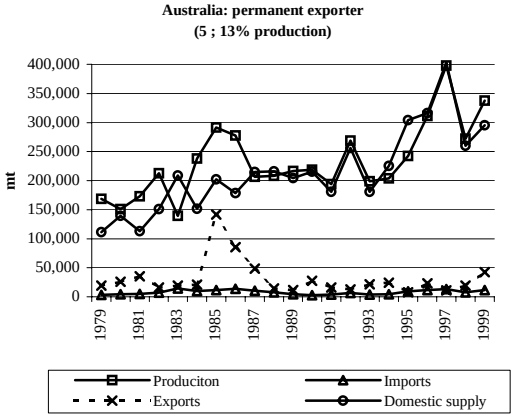
The Republic of Korea, Malaysia and Japan (and Fiji Islands) were permanent importers because of an extremely low level of production, while all the other countries imported regular quantities to complement their production.

Figure 22 displays contrasted cases of links between maize domestic production, imports, exports and domestic supply and therefore highlight different strategies according to the specific conditions of the countries.

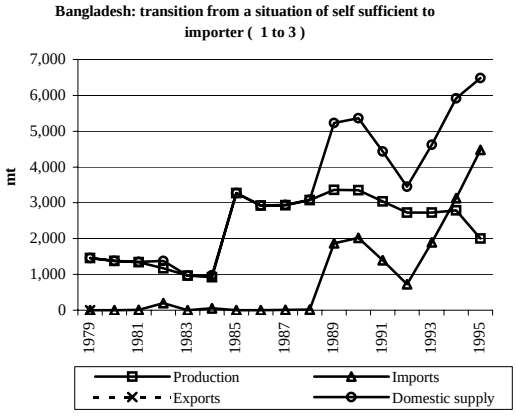
Figure 22. The import/export situation of six contrasting ESCAP countries



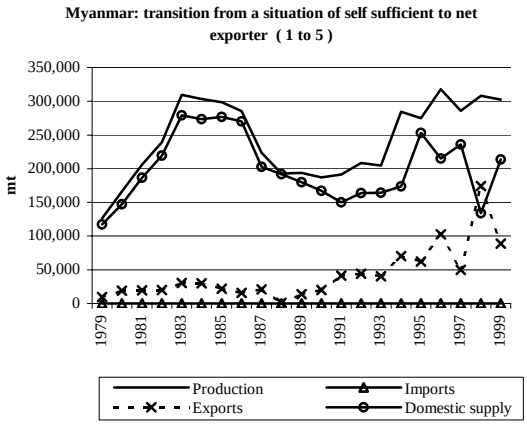
Increasing domestic supply totally depends on imports.



Imports and exports marginally affect domestic supply. Regular exports of production.



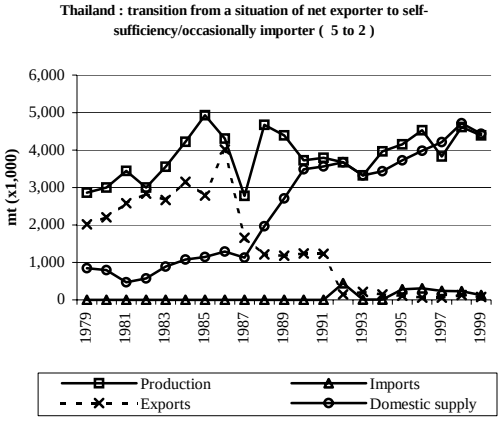
Domestic supply is first related to local production and then to imports since 1988.



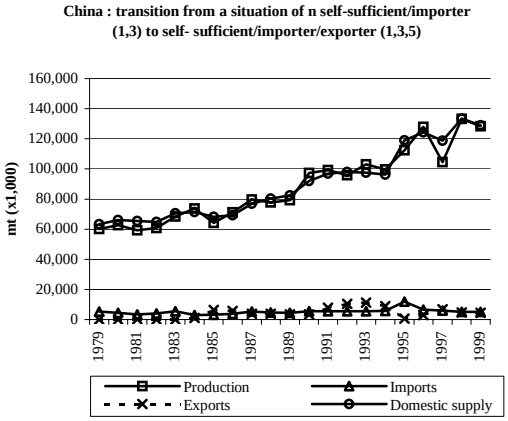
Production exceeds domestic supply as of 1988. Exports rise stedly

Continued …..

Figure 22. The import/export situation of six contrasting ESCAP countries (continued)



Increasing domestic supply reduces exports.



Domestic supply is strongly related to local production. Exports and imports are high but stay comparatively marginal.

Socio-economic determinants of coarse grain consumption

Animal feed development

The development of the husbandry sector in Asia and the Pacific (analytical framework section) has led to an increase in the demand for animal feed, which in turn affects coarse grain development.

The quantity of maize used for animal feed within domestic supply has increased from 54 million mt in 1980 to 113 million in 1999 (55 per cent of the maize domestic supply for the period). This demand for animal feed has boosted the production of coarse grains. The quantity of maize used for animal feed has experienced a 127 per cent growth in twenty years while quantities increased by only 48 per cent for processed and unprocessed food.

On a national scale, many correlations between the level of domestic supply of maize and size of livestock population can be noticed. The following figures illustrate correlations between maize domestic supply and respectively: pig head numbers in China (where 80 per cent of the pig herds in the region are located), chicken head numbers for Indonesia, and cattle head numbers for Viet Nam.

Figure 23. Correlation between maize domestic supply (mt) and pig head numbers in China from 1979 to 1999

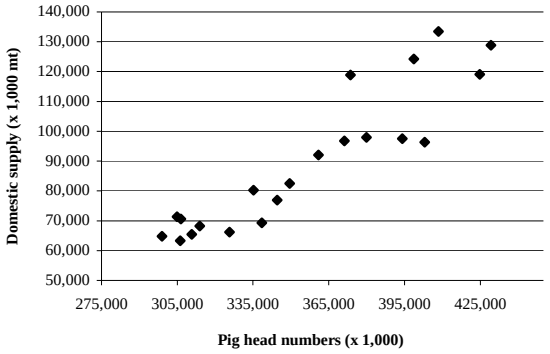


Figure 24. Correlation between maize domestic supply (mt) and cattle head numbers in Viet Nam from 1979 to 1999

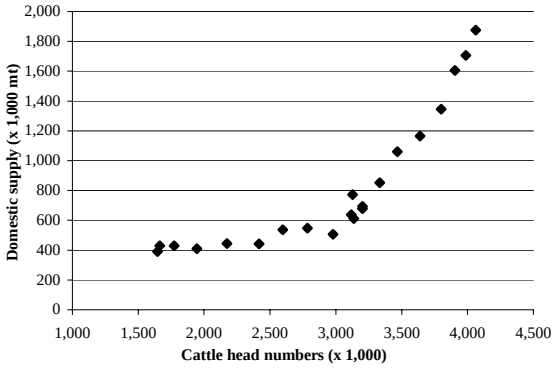
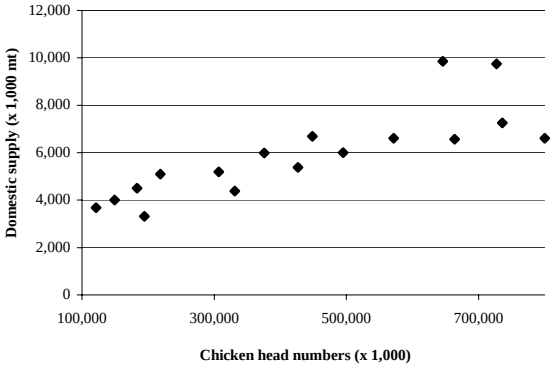
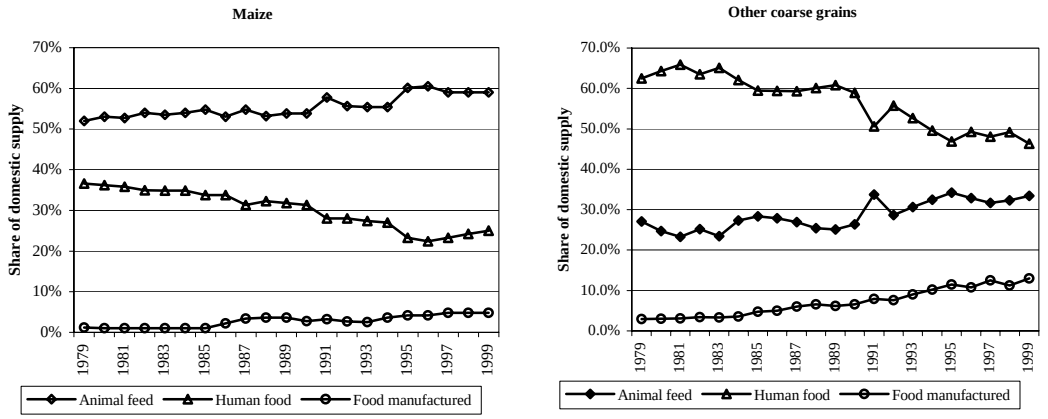


Figure 25. Correlation between maize domestic supply (mt) and chicken head numbers in Indonesia from 1979 to 1999



Both for maize and other coarse grains, the general tendency was a slow but regular increase in the share of animal feed within the domestic supply. For maize, this share increased from 52 per cent to 59 per cent; for coarse grains an increase of 6.4 per cent was registered (reaching 33.4 per cent in 1999), as displayed in Figure 26. In parallel, the share used for human food decreased, while, manufactured coarse grains share has increased steadily since 1985.

Figure 26. Share of domestic supply of maize and other coarse grains used as feed, and processed and unprocessed food



Viet Nam and Myanmar illustrate this trend well. The share of animal feed in domestic supply was respectively 18 per cent and 25 per cent in 1979 reaching more than 69 per cent and 42 per cent in 1999. Also, some countries remained marginal against this general trend, as they have different consumption habits (Indonesia, Cambodia, India, Democratic People's Republic of Korea and other non significant countries in terms of domestic supply level).

The general trend shows that the share of maize used for animal feed was more significant for countries with a high urban population, which are also the countries that had an increasing requirement for derived animal products.

All countries with a share of rural population below 50 per cent (Malaysia, New Zealand, Japan, Republic of Korea and Australia) with the exception of Thailand and Fiji Islands, present the highest share of animal feed in domestic supply. For the region, the coefficient of correlation between the share of rural population and share of animal feed within domestic supply was -0.62. It is even more significant for some specific countries as indicated in Figure 27 and Table 19.

Figure 27. Share of animal feed within domestic supply and percentage of rural population (average, 1979-1999)

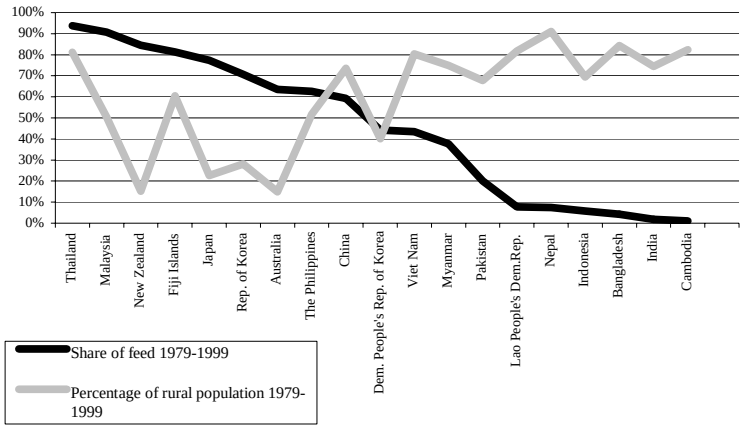


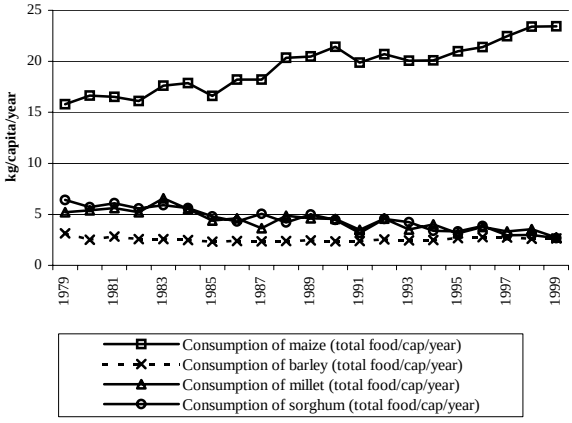
Table 19. Coefficient of correlation between percentage of rural population and share of domestic supply used as feed

Country	All countries (average period)	Thailand (1979-1999)	The Philippines (1979 to 1999)	China (1979 to 1999)
Coefficient of correlation	-0.613	-0.777	-0.834	-0.902

Human consumption

The consumption of maize as a source of animal feed increased as previously mentioned boosting the total consumption of maize in the region. At the same time, the distribution of uses of coarse grains in domestic supply experienced a change. Comparatively, larger quantities of coarse grains were directed to animal feed as well as to processed food.

Figure 28. Human consumption of some coarse grains (kg/capita) from 1979 to 1999



The consumption of processed and unprocessed sorghum and millet per capita per year decreased. Barley consumption remained almost stable (small fluctuations). Only maize consumption increased significantly from 15.8 kg/capita (1979) to 23.4 kg/capita/year (1999).

These results hide very large discrepancies amongst the countries. The main consumer of maize throughout the period was Nepal with around 47 kg/capita on average. For sorghum, there are only a few consumer countries: among them the main one being India with 11 kg/year (period). India was also the main consumer of millet (10.5 kg/capita/year for the period). Republic of Korea consumed 10.7 kg/capita/year of barley, far above the others countries.

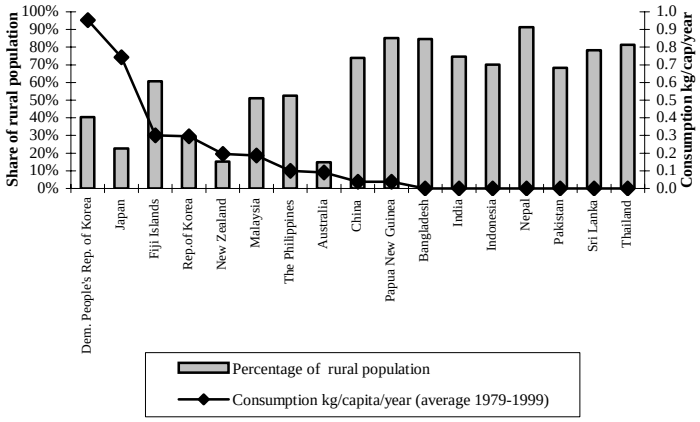
The increased processing of coarse grains for human food concerned mainly maize (for oil) and barley (for malt). Human consumption of maize oil increased regularly during the last twenty years. Regional production grew from 1980 to 1999 by 113 per cent, reaching around 215 thousand mt. The main consumers of maize oil are both producing countries (Japan, Australia, New Zealand, Republic of Korea, Democratic People's Republic of Korea, the Philippines, China), and importing countries (Malaysia, Fiji Islands). All of these nine countries have in common:

- *A significant urban population*. There is a relationship between a low percentage of rural population and a high level of maize oil consumption. Bangladesh, India, Indonesia, Nepal, Pakistan, Sri Lanka, and Thailand, which are all countries with the most significant rural population (exceeding 70 per cent), are also the ones with the lowest level of maize oil consumption. Oppositely, all the main consumer countries have a rural population below 60 per cent. A coefficient of correlation above 0.8 has been found for all the main producer countries between maize oil production and rural population.
- *The highest HDI values of the ESCAP countries*. Japan, Australia, New Zealand, Republic of Korea, Fiji Islands, the Philippines and Malaysia all have an HDI value of above 0.7.

Table 20. Coefficient of correlation between maize oil production and the percentage of rural population from 1979 to 1999

Country	Coefficient of correlation
Japan	-0.875
China	-0.896
Democratic People's Rep. of Korea	-0.866
The Philippines	-0.902
Rep. of Korea	-0.894

Figure 29. Consumption of maize oil and percentage of rural population for the selected countries (average, 1979-1999)

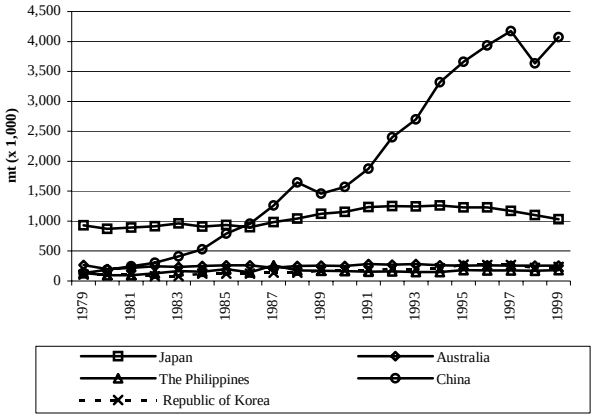


Barley is mostly processed for malt. The share of quantities of barley used for manufactured food within the domestic supply increased from 2.9 per cent (1.7 million mt) to 13 per cent (6.3 million mt), mainly due to China's influence.

Five countries, namely, Japan, the Philippines, Republic of Korea, Australia and China represent more than 90 per cent of the quantity of barley processed throughout the period.

All of these countries had an HDI value above 0.72 in 2000.

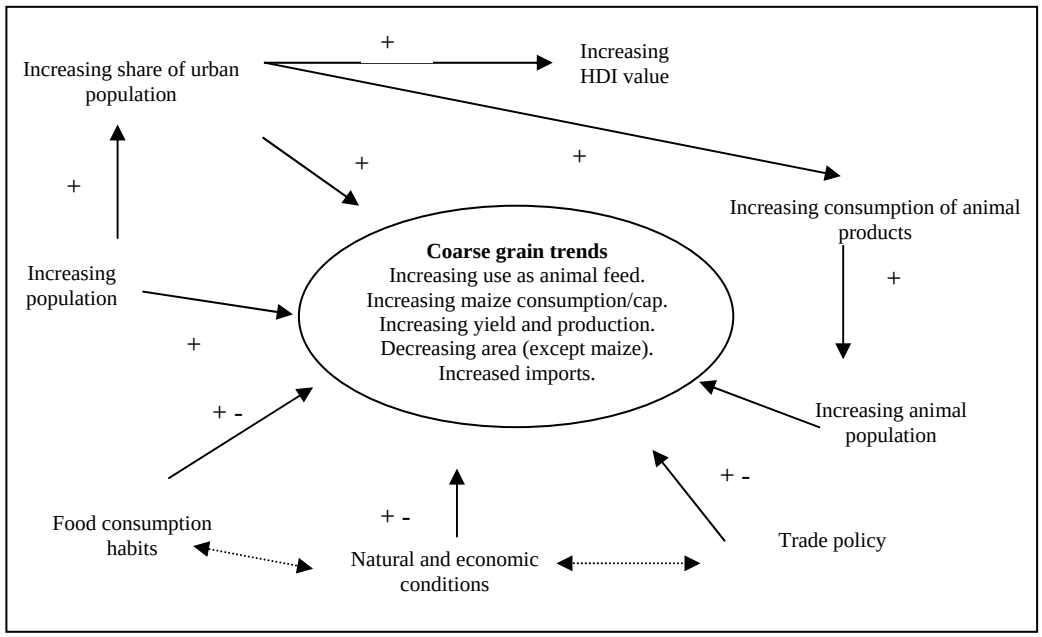
Figure 30. Quantity of barley used as manufactured food



Conclusion: Future development of coarse grains in the region

According to what has been discussed above, many qualitative and quantitative variables influence different aspects of coarse grain trends as summarised below.

Figure 31. Flow chart to show the influencing factors of coarse grain trends



The selected countries are evolving in different and individual ways. Still, three patterns may be identified: each one –characterized by socio-economic indicators – relates to different situations in coarse grain/maize trends:

One pattern (A) (Bangladesh, PNG, Pakistan, Nepal, Cambodia, Lao People's Democratic Republic) is found for countries with a low HDI and limited access to the world market. Imports and exports are not significant in volume. With a dominant rural population (more than 75 per cent), maize is mostly for human consumption. They are usually self sufficient, and both production and harvested area is increasing. Capacity to improve yield is considerable.

An intermediate pattern (B) (India, Indonesia, the Philippines) for countries that have reached sufficient production to partially export. Rural population is decreasing (around 50-75 per cent), and the HDI is improving.

A third pattern (C) is found in Japan, Republic of Korea, Australia and New Zealand, high income per capita countries with more than 75 per cent urban population. Access to markets is easy and the human consumption pattern is mostly oriented to processed food for human consumption. As they only produce a little maize (or are not self sufficient), they import large volumes. They can also be exporters of processed maize food. In these countries, domestic supply is primarily used for animal feed requirements.

Several other countries are in-between these patterns: Viet Nam and Sri Lanka are located between pattern A and B; Malaysia, Thailand and China between B and C, as indicated in Table 21.

Table 21. Evolution patterns of the selected ESCAP countries

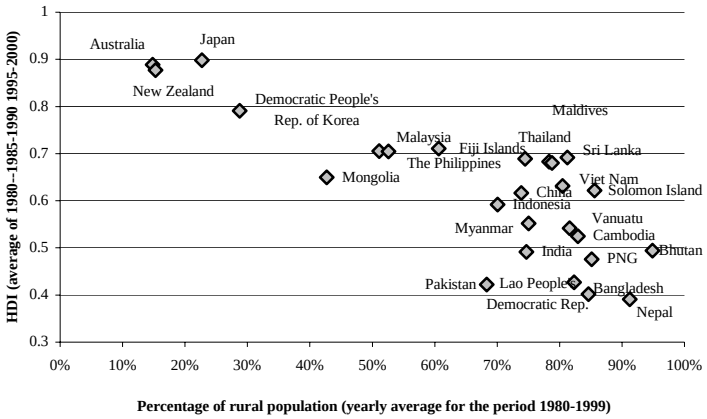
	Pattern A	Trasnsition	Pattern B	Transition	Pattern C
Social and economic situation	Low access to market HDI low Rural population > 75 per cent		Good access to market HDI low to medium Rural population above or closed to 50 per cent		High access to market HDI high Rural population < 25 per cent
Pattern of consumption	Low consumption of processed food Maize use for human good		Increasing consumption of processed food Maize used both for human food and animal feed	Increasing	High consumption of processed food (derived animal products, oil of maize) Maize used essentially to meet animal feed requirements
Trend of coarse grain/maize components	Self-sufficient for maize No import No export Production increassing Harvested increasing	Increasing Increasing	Surplus of production for maize Start to import Increasing export Production increasing Stabilization of harvested areas	Increasing Reducing/stabili-zation	Non-self sufficient for maize High import High export (processed) Low or decreasing of production Low or decreasing of harvested areas
Countries	Bangladesh, Nepal, Pakistan, Cambodia, Lao People's Democratic Republic, Bhutan, Vanuatu, Solomon Islands, Papua New Guinea	Viet Nam, Sri Lanka, Myanmar	Fiji Islands, Mongolia, India, Indonesia, the Philippines	Thailand, Malaysia, China, Democratic People's Rep. of Korea	Japan, Australia, New Zealand, Rep. of Korea

The demand for coarse grains should increase significantly in the coming years for several reasons. Firstly, it is estimated that the population of Asia and the Pacific will increase

(+1 per cent, meaning an increase of 15 million people in 2010 compared to 2000). Globally, demand for coarse grains for human food should increase.

Secondly, as most of the countries in Asia and the Pacific still have a rural population of more than 75 per cent, but with urban growth exceeding 3 per cent per year, the urban population will continue to grow in the future, favouring an increase in demand for processed food, and consequently generating– directly (consumption of processed food) or indirectly (production of meat and derived products) – an increase in maize/coarse grain requirement (Figure 32).

Figure 32. Correlation between HDI and rural population



Finally, access to markets will develop or improve for all countries in the region, favouring trade exchange. More significant importers and exporters may become present in the market.

Thus, the satisfaction of needs for coarse grains, especially maize, will be a challenge for Asia and the Pacific. The countries will probably have to become more dependent on the supply from other countries. Their capacity to increase local production through competitive faming systems will be a key element should national policies aim at breaking increasing dependence. India and China will represent 39 per cent of the world cereal demand by 2020 (IFPRI IMPACT cited by Massari, 2000) and China, with grain demand expected to reach 560 million tons in 2010 (Feng and Han, 2000) will be a key stakeholder. China's coarse grain net imports are forecasted to reach 8 to 10 million tons by 2009 (European Commission, 2002).

Part III
Pulses

Importance of pulses

The pulses' group

Pulses, according to FAO, are annual leguminous crops yielding from one to 12 grains or seeds of variable size, shape and colour within a pod. They are used for both food and feed. In this study, pulses have been divided into three categories.

Soybean has been cultivated in Asia for a long time for both human food and animal feed. It is mostly used for its grains: fresh green grain and germ grain represent high value vegetables; dried grain can be consumed directly or processed (flour is used in different ways as sauce, soup, cake); grain can also be used in the preparation of soybean milk. However, soybean grains, as they contain 18 to 25 per cent lipid, are currently predominantly processed into oil. Today, soybean oil is the most common among vegetable oils. The residue from the extraction of oil (oilcakes), which contains high quantities of protein (35 to 40 per cent), a lot of mineral salts (lime, potash, phosphor, iron) and vitamins, is consequently used for animal feed.

Groundnut[1] is cultivated for its grain which is consumed directly, especially in the poorest countries, or processed in order to extract oil. The residue from the extraction is used as animal feed.

Other pulses corresponds here to crops harvested solely for dry grain, thereby excluding crops harvested green for food (green peas, green beans, etc.), which are classified as vegetable crops. Also excluded are those crops used mainly for oil extraction (e.g. soybean and groundnut) and leguminous crops (e.g. seeds of clover and alfalfa) that are used exclusively for sowing purposes. FAO covers 11 primary pulses: dry beans, dry broad beans, dry peas, chick peas, dry cow peas, pigeon peas, lentils, bambara beans (these beans are grown underground in a similar way to groundnut), vetches (used mainly for animal feed), lupins (used primarily for feed), and pulses nes (other pulses that are not identified separately because of their minor relevance on an international level).

In addition to their food value, pulses also play an important role in cropping systems because of their ability to produce nitrogen and thereby enrich the soil. They contain carbohydrates, mainly starches (55-65 per cent of the total weight); proteins, including essential amino acids (18-25 per cent, and much higher than cereals); and fat (4 per cent). The remainder consists of water and inedible substances.

Pulses in the world and in Asia and the Pacific

With a little more than one fifth of the world's harvested area grown with soybean, Asia and the Pacific's share of world production[2] is only 15 per cent. Imports to the region represent around one third of world imports.

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[1] All data concerning groundnut will be "shelled equivalent".

[2] Production data for all pulses is reported in dry clean weight, excluding the weight of the pods. Certain kinds of pulses can be skinned and partially crushed or split to remove the seed coat, but the resulting products are still considered raw for classification purposes.

Table 22. Distribution of soybean, groundnut and other pulses (per cent)

Share of Asia and the Pacific within the world (1979 to 1999)		Other pulses	Soybean	Groundnut
Production	1979	54	11	57
	Average	46	15	61
	1999	49	15	55
Harvested area	1979	52	19	58
	Average	50	23	67
	1999	50	23	65
Imports	1979	6	25	12
	Average	6	32	22
	1999	7	39	25
Exports	1979	5	1	12
	Average	10	3	39
	1999	11	1	48

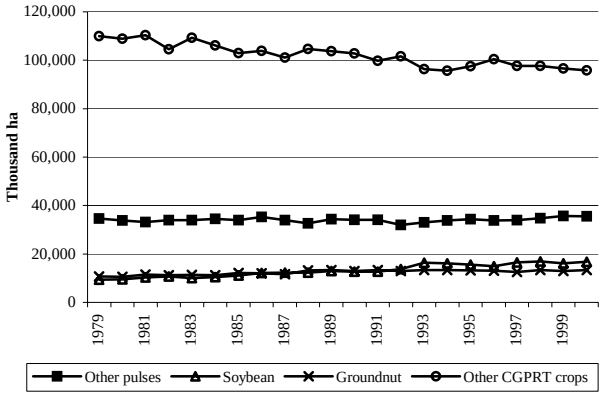
Groundnut in the region represents around two thirds of both world production and area, a little less than one quarter of world imports and more than one third of world exports.

Asian and Pacific other pulses occupy a significant position in the world, with around half of the harvested area and production regarding the said period. Trade did not exceed 10 per cent of the world exchange.

The total harvested area of pulses increased regularly during the last 20 years, reaching in total 65.6 million ha in 2000. It has consequently followed an opposite trend compared to the other CGPRT crops, which experienced a decrease by 14 million ha from 1979 to 2000.

As such, the share of pulses' harvested area within the CGPRT crops increased from 33.2 per cent (1999) to 40.7 per cent (2000).

Figure 33. Evolution of the harvested area of soybean, groundnut, other pulses and other CGPRT crops (coarse grains) in the selected ESCAP countries from 1979 to 2000



On average for the period, pulses contributed around 30 per cent of the CGPRT crops export value (US$ 33 billion); 7.8 per cent from groundnut, 6.2 per cent from soybean and 15.8 per cent from other pulses.

The share of other pulses has more than doubled in 20 years (22.9 per cent in 1999 compared to 10.4 per cent in 1979).

Figure 34. Distribution of income from exports (1979-1999)

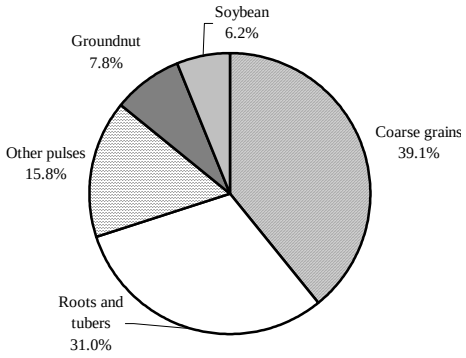
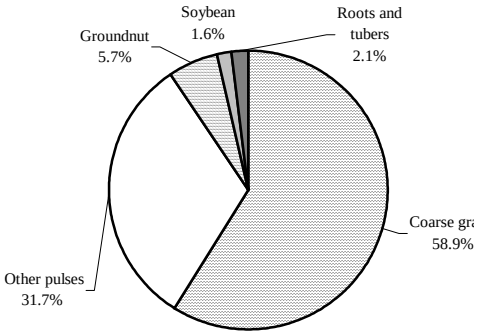
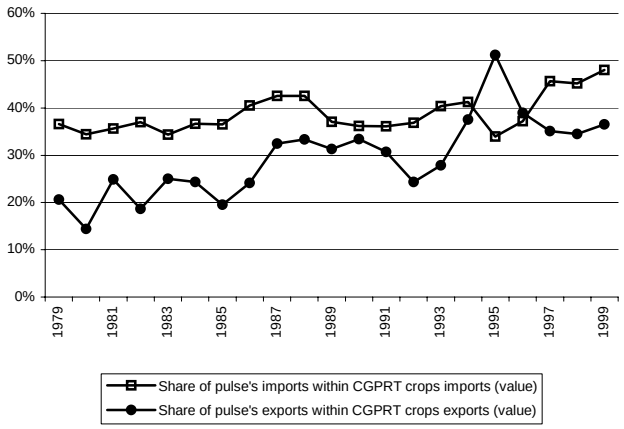


Figure 35. Distribution of expenses from imports (1979-1999)



Regarding import value, the share of pulses was 39 per cent, representing US$ 68 billion for the last twenty years. This share increased from 36 to 48 per cent during the two last decades, and this increase was especially noticeable for other pulses.

Figure 36. Share of pulses within CGPRT crops' imports and exports (value)



Domestic supply largely influenced by trade

A general increase in production

Area

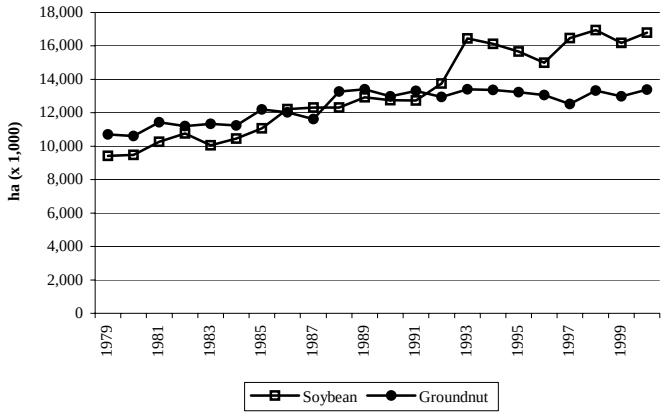
A significant increase in harvested area characterizes the pulses group. However, other pulses harvested area has not varied significantly during the last 20 years, oscillating irregularly between 32 million and 35.5 million ha. Beans and chickpeas make up more than 60 per cent of the other pulses area. Beans, pigeon peas, lentils and lupines have all expanded while minor pulses total area shrank almost twofold.

Table 23. Harvested area and share of various pulses

	1979		Average for the period		2000	
	Harvested area (ha)	Share (%)	Harvested area (ha)	Share (%)	Harvested area (ha)	Share (%)
Beans (dry)	11,951,861	34.6	12,301,172	38.1	14,428,437	40.7
Broad beans (dry)	2,311,475	6.7	1,304,331	4.0	1,154,180	3.3
Peas (dry)	2,469,691	7.1	1,976,915	6.1	1,919,960	5.4
Chick peas	9,265,176	26.8	7,999,893	24.7	8,271,746	23.3
Cow peas (dry)	58,154	0.2	73,743	0.2	127,000	0.4
Pigeon peas	2,712,218	7.8	3,405,955	10.5	4,471,260	12.6
Lentils	1,518,478	4.4	1,533,153	4.7	1,723,969	4.9
Bambara beans		0.0		0.0		0.0
Vetches	475	0.0	25,405	0.1	39,000	0.1
Lupins	10,830	0.3	960,089	3.0	1,164,000	3.3
Pulses nes	4,168,269	12.1	2,746,054	8.5	2,190,997	6.2
Other pulses (without soybean and groundnut)	34,561,627	100.0	32,326,709	100	35,490,549	100

The harvested area of soybean and groundnut increased regularly, reaching 16.8 million ha and 13.4 million ha respectively in 2000. This represents an additional 7.4 million ha of soybean cultivated over the period (+78 per cent) and 1.7 million ha of groundnut (+25 per cent). Since 1992, soybean has covered a larger area than groundnut.

Figure 37. Harvested area of soybean and groundnut from 1979 to 1999 for the selected ESCAP countries



The two biggest countries in Asia and the Pacific, India and China**,** largely dominate the production of pulses in terms of planted area. More than 67 per cent of the pulses were harvested in India throughout the period, a stable figure, while China's harvested area decreased twofold compared to 1979. Groundnut in India and China represents more than 86 per cent of the region's harvested area. The two countries experienced an inverse trend, with India's groundnut area share decreasing by 6 per cent and China's increasing by 6 per cent. However, India's share still remained above 60 per cent until 2000.

Around 54 per cent of the area grown with soybean is located in China, but it is declining compared to 1979 (-16 per cent of the regional share). Meanwhile, India's share of soybean harvested area increased significantly, from 5.3 per cent in 1979 to around 34 per cent in 2000 (+28.6 per cent).

Figure 38. Distribution of other pulses, soybean, and groundnut harvested area (average 1979-1999)

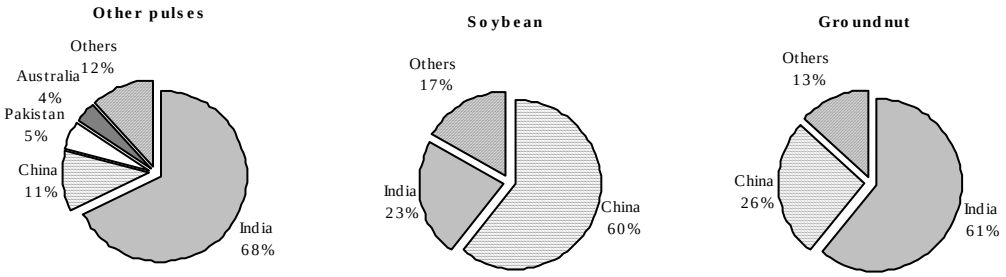


Table 24. Evolution of India and China harvested area's share within the region (per cent)

Country	Other pulses		Soybean		Groundnut	
	1979	2000	1979	2000	1979	2000
India	67.2	67.3	5.3	33.9	66.9	60.9
China	16.0	8.2	77.1	53.8	19.9	25.7

Yields

On a regional scale, the yield of pulses, soybean and groundnut experienced a noticeable increase: +19 per cent for pulses, +38 per cent for soybean and a spectacular +82 per cent for groundnut, in 20 years.

However, the situation varies widely depending upon the country, as can be observed in Table 25.

Figure 39. Yield of other pulses, soybean and groundnut from 1979 to 1999 for the selected ESCAP countries

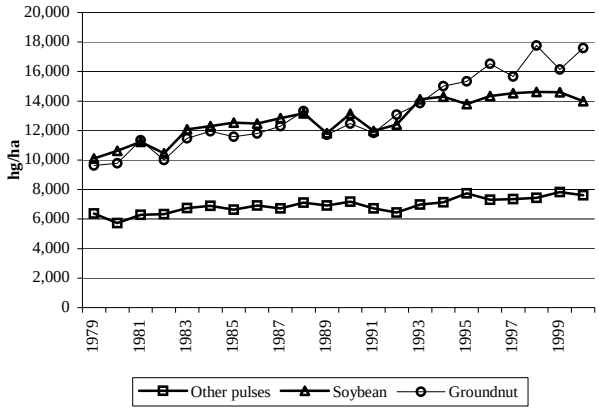


Table 25. Trend of average yield for pulses

(Average yield period 1996 to 2000) – (Average yield period 1979 to 1984) hg/ha	Decreasing	Increasing			
		> 4,000	[2,000; 4,000]	[1,000; 2,000]	< 1,000
Other pulses	The Philippines, Sri Lanka	Indonesia, Fiji Islands, Japan	Solomon Islands, Mongolia, China, Lao People's Democratic Republic, Bhutan	Australia, Nepal, Pakistan, Maldives, Viet Nam, India, Rep. of Korea, Thailand	Bangladesh, Myanmar, Cambodia, New Zealand, Papua New Guinea, Democratic People's Rep. of Korea
Soybean	Malaysia, (New Zealand)	Cambodia, China, Pakistan, Viet Nam	Australia, India, Thailand, Japan, Indonesia, Nepal, the Philippines, Rep. of Korea	Myanmar, Bhutan, Lao People's Democratic Republic	Democratic People's Rep. of Korea, Sri Lanka
Groundnut (shelled)	Pakistan	China, Viet Nam, Rep. of Korea, Lao People's Democratic Republic, Japan, Australia	Thailand, Myanmar, Fiji Islands	India, Malaysia, Cambodia, Indonesia, the Philippines	Sri Lanka, Vanuatu, Bangladesh, Papua New Guinea

Production

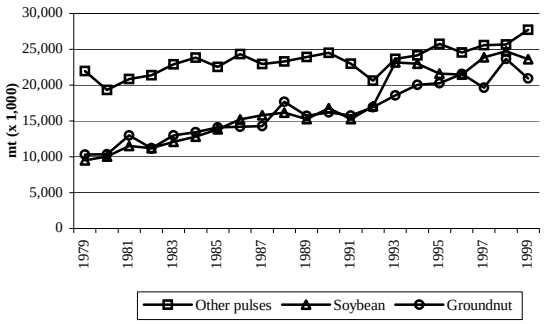
As a result from a combination of general increases in harvested area and yield, the production of pulses, soybean and groundnut have registered an increase since 1979, but the growth rate varied among the crops.

Little change in the harvested area, but increasing yields induced limited growth in the production of other pulses during the last 20 years, with an average of 23.5 million mt for the period and a progression of 2.8 million mt.

The production of soybean has multiplied by 2.5 in 20 years, reaching in 2000 around 23.6 million mt, with a spectacular increase in the early 90's driven by the development of soybean in India. Since 1996, production stabilized in the range of 22/24 million mt.

The production of groundnut was more steady but has also doubled in twenty years and reached in 1999 around 21 million mt. Groundnut production growth is mainly due to huge yield improvements during the period, especially in China.

Figure 40. Production of other pulses, soybean and groundnut from 1979 to 1999 in the selected ESCAP countries



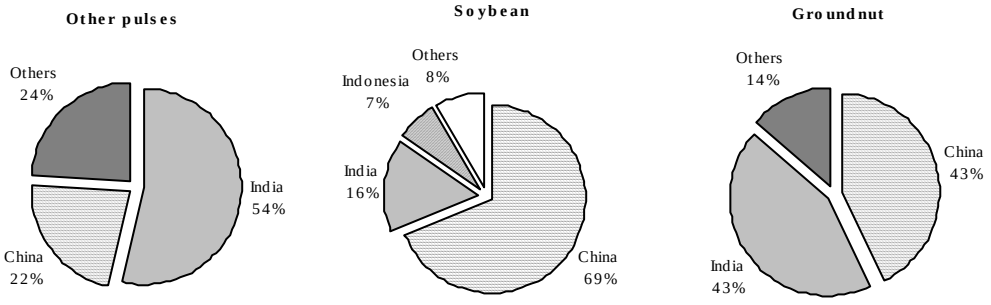
Depending on the country and the crop, the following situations could be observed:

Table 26. Evolution of production of other pulses, soybean and groundnut 1979-1999

Evolution of the production (1979-1999)	Not producer	Stable	Increasing	Decreasing	Smooth variation	Irregular
Other pulses	Vanuatu	The Philippines	India, Thailand, Fiji Islands, Myanmar, Indonesia, Australia, Nepal, Viet Nam, Lao People's Democratic Republic, Maldives, Solomon Islands, Papua New Guinea	China, Sri Lanka, Rep. of Korea	Bangladesh	Pakistan, Democratic People's Rep. of Korea, Japan, New Zealand, Cambodia, Bhutan, Mongolia
Soybean	Bangladesh, Fiji Islands, Maldives, Mongolia, Papua New Guinea, Solomon Islands, Vanuatu		Bhutan, China, India, Indonesia, Viet Nam, Myanmar, Cambodia, Nepal, Pakistan	Rep. of Korea, the Philippines, Sri Lanka, Malaysia, New Zealand		Democratic People's Rep. of Korea, Thailand, Japan, Australia, Lao People's Democratic Republic
Groundnut (shelled)	Bhutan, Democratic People's Rep. of Korea, Maldives, Mongolia, Nepal, New Zealand, Solomon Islands	Vanuatu	China, India, Viet Nam, Indonesia, Pakistan, Lao People's Democratic Republic, Fiji Islands	The Philippines, Japan, Malaysia	Papua New Guinea	Myanmar, Thailand, Australia, Bangladesh, Rep. of Korea, Sri Lanka, Cambodia

Due to significant differences in yields, the distribution of production was quite different than the one observed for harvested area. It is especially noticeable for groundnut where China with only 25 per cent of the harvested area equals India's production on 60 per cent of the harvested area, with 43 per cent of the region's production.

Figure 41. Distribution of other pulses, soybean, and groundnut production (average 1979-1999)



Contrasted trade patterns and actors

Imports

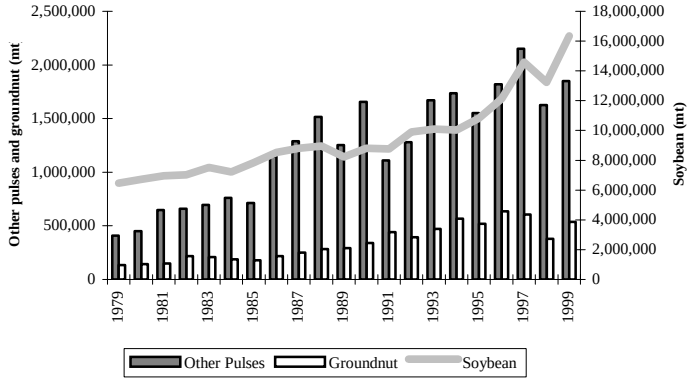
Imports have been very significant for soybean, a little less for other pulses, and negligible for groundnut.

Soybean regional imports increased from 6.5 million mt in 1979 to more than 16.3 million mt in 2000 (see Appendix 3). On average, imported quantities of soybean have represented around 56 per cent of the local production and 18 times the exported quantity.

Imports of other pulses have also increased during the last two decades, reaching more than 1.8 million mt in 1999, compared to 408 thousand mt in 1979. However, these imports represent only 5 per cent of the production for the whole period.

Imports of groundnut never exceeded 3 per cent of the level of production, reaching 0.5 million mt in 1999.

Figure 42. Imports of other pulses, soybean and groundnut from 1979 to 1999 to the selected ESCAP countries



The situations are very contrasting depending on the country as can be seen in Table 27.

Table 27. Evolution of imports of other pulses, soybean and groundnut, 1979-1999

Evolution of imports (1979-1999)	None	Increasing	Decreasing	Irregular
Other pulses	Cambodia, Myanmar, Solomon Islands, Vanuatu, Lao People's Democratic Republic, (Papua New Guinea)	India, Pakistan, Fiji Islands, China, Sri Lanka, the Philippines, Malaysia, Thailand, New Zealand,	Maldives	Japan, Rep. of Korea, Indonesia, Australia, Viet Nam, Democratic People's Rep. of Korea, Nepal
Soybean	Cambodia, Lao People's Democratic Republic, Maldives, Vanuatu, Solomon Islands, Myanmar, (Pakistan, Papua New Guinea, Fiji Islands, Bangladesh, Nepal)	Japan, China, Rep. of Korea, Indonesia, Malaysia, the Philippines, Australia	Thailand, New Zealand	Democratic People's Rep. of Korea, Sri Lanka, Viet Nam, India
Groundnut	Cambodia, Democratic People's Rep. of Korea, Myanmar, Vanuatu, Solomon Islands, Viet Nam, (Maldives, Bangladesh)	Japan, Indonesia, the Philippines, Malaysia, Rep. of Korea, Thailand, China, Sri Lanka, Fiji Islands, India		Australia, Thailand, Papua New Guinea, Pakistan, Nepal

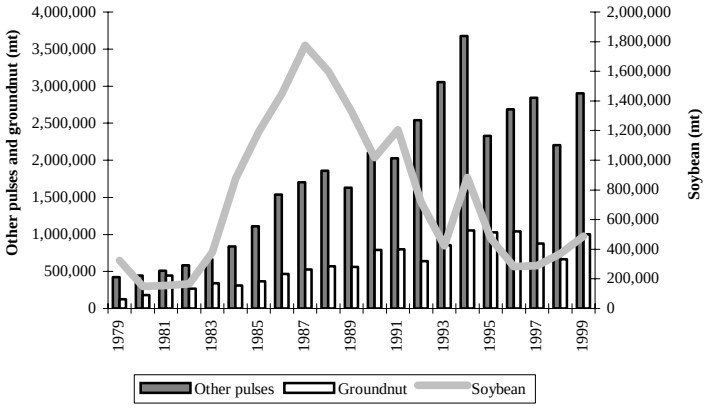
Exports

Until 1994, exports of other pulses and groundnut increased regularly, then stabilized or varied only slightly.

Other pulses exports have increased from 0.4 million mt in 1979 to around 1.8 million mt in 1999 (maximum registered in 1994), representing more than 7 per cent of the region's production.

The regional exports of groundnut also increased significantly from 0.1 million mt in 1979 to 1 million mt in 1999.

Figure 43. Export of other pulses, soybean and groundnut from 1979 to 1999 for the selected ESCAP countries



For soybean, the trend was irregular with exports increasing until 1987, up to 1.7 million mt, followed by a regular but sometimes erratic decrease until 1999 (0.7 million mt). China's production and consumption levels strongly influenced these variations. Altogether, the exported quantities remain comparatively small to the level of imports, representing less than 4.5 per cent of the region's production.

Situations were very contrasted depending on the country as shown in Table 28.

Table 28. Evolution of exports of other pulses, soybean and groundnut, 1979-1999

Evolution of exports (1979-1999)	None	Increasing	Decreasing	Irregular
Other pulses	Lao People's Democratic Republic, Maldives, Papua New Guinea, Solomon Islands, Vanuatu, (Fiji Islands, Bangladesh)	Australia, China, Myanmar, Nepal, India, Indonesia	Thailand, New Zealand	Pakistan, Viet Nam, the Philippines, Japan, Sri Lanka, Rep. of Korea, Cambodia, Democratic People's Rep. of Korea
Soybean	Bangladesh, Maldives, Nepal, Pakistan, Papua New Guinea, Solomon Islands, Vanuatu, (Fiji Islands, Sri Lanka)	Malaysia, Myanmar, Thailand, the Philippines, Japan, New Zealand		China, Viet Nam, Lao People's Democratic Republic, Cambodia, India, Rep. of Korea, Indonesia, Democratic People's Rep. of Korea
Groundnut	Bangladesh, Cambodia, Democratic People's Rep. of Korea, Maldives, Papua New Guinea, Nepal, Vanuatu, Solomon Islands, (Fiji Islands, Sri Lanka, Pakistan)	India, Viet Nam, China, Malaysia, Indonesia, Japan, the Philippines	Thailand	Australia, Lao People's Democratic Republic, Rep. of Korea, Myanmar, New Zealand

Trade balance

The level of imports and exports clearly show that soybean is highly traded, with increasing imports but negligible exports. For groundnut and other pulses, trade became less and less, year after year, mostly oriented towards exports. However, for these two latter crops, the quantities imported and exported always remained on the same scale.

Figure 44. Imports and exports of soybean from 1979 to 1999 for the selected ESCAP countries

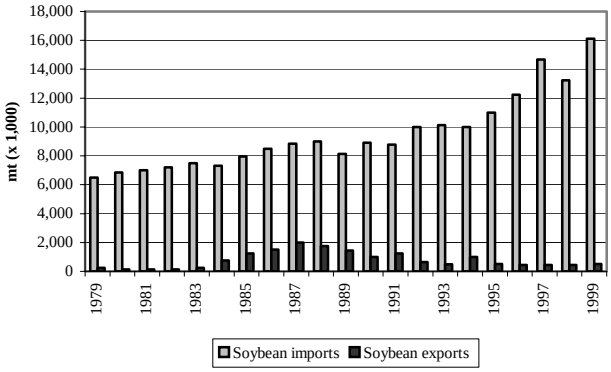


Figure 45. Imports and exports of groundnut from 1979 to 1999 for the selected ESCAP countries

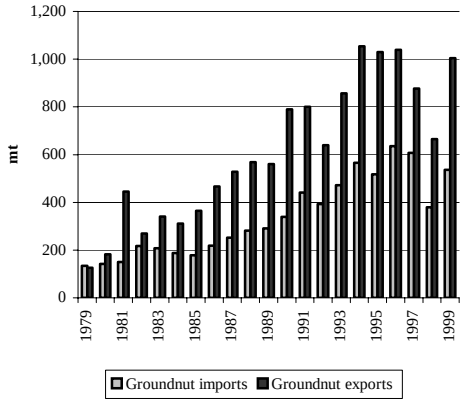
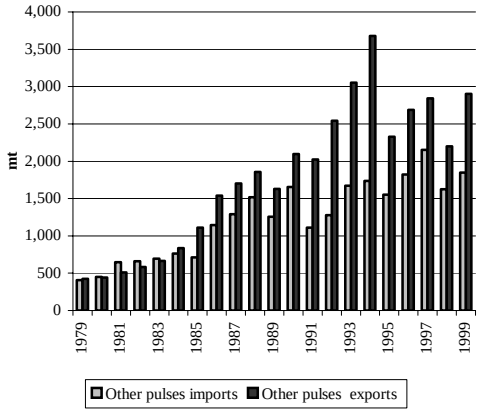


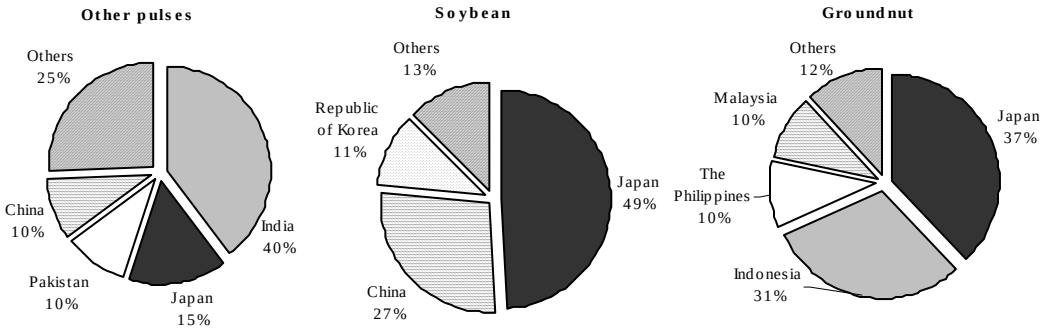
Figure 46. Imports and exports of other pulses from 1979 to 1999 for the selected ESCAP countries



Actors

The main importers of other pulses remained unchanged throughout the period. India's share within the region's imports was 40 per cent, followed by Japan (15 per cent) and China and Pakistan (10 per cent each). Japan was the main importer of soybean (49 per cent) but was overtaken by China in 1997. Regarding groundnut, Japan imported 37 per cent of the region's imports for the period with Indonesia representing around 31 per cent. However, since 1987, Indonesia has been the largest importer of groundnut.

Figure 47. Distribution of imports of other pulses, soybean and groundnut, 1979-1999

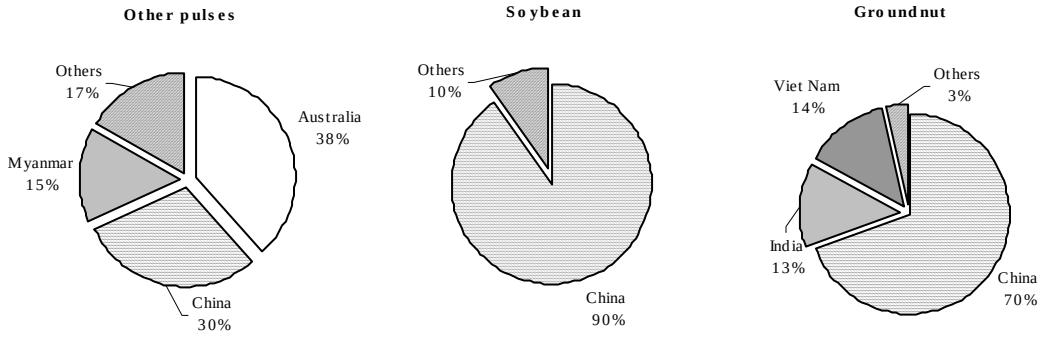


The main exporters of other pulses are Australia (38 per cent of the region's total exports on average for the period), China (30 per cent) and Myanmar (15 per cent). Thailand, which was the largest exporter in 1979 (half of the region's exports), exported less than 50 thousand mt in 1999 (20 per cent of the export level registered in 1999).

Regarding soybean, China is the largest exporter with 90 per cent of the region's exports. However, China's share has diminished since 1994 due to a significant increase in Vietnamese, Malaysian and Australian exports. Indeed, from 95 per cent in 1994, China's share has been halved to just 45 per cent in 1999; however, the exported quantities of soybean varied greatly from one year to another.

China's groundnut exports were also dominant, representing around 70 per cent of the region's total, followed by Viet Nam (14 per cent) and India (13 per cent).

Figure 48. Distribution of exports of other pulses, soybean and groundnut, 1979-1999



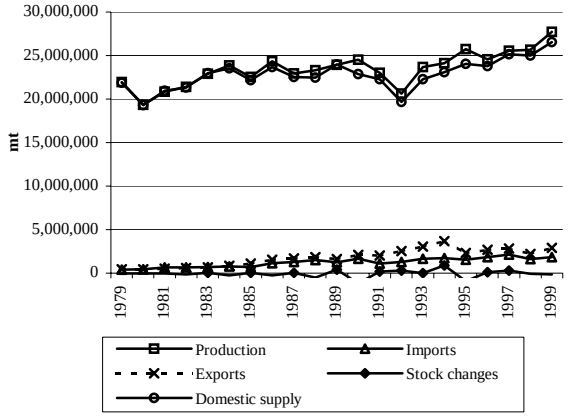
Domestic supply and local demand

The domestic supply of all pulses experienced significant increases. Depending on the crop, the reasons for this vary: production and exports (other pulses), production and imports (soybean) and production (groundnut).

Other pulses' domestic supply reached 26.5 million mt in 1999, after an increase of 4.6 million mt.

Regarding the whole period, domestic supply has followed the same trend as production (slow increase), but has always stayed a little lower as exports were more significant than imports.

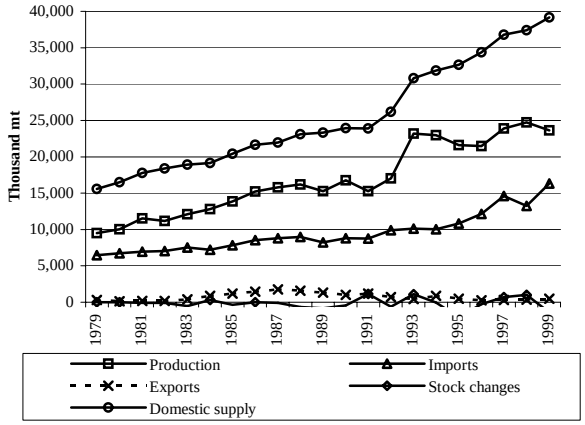
Figure 49. Domestic supply and its components of other pulses for the selected ESCAP countries



For soybean, regional domestic supply increased due to a combination of growing domestic production and growing imports, while exports remained of little significance (and actually decreased as of 1992).

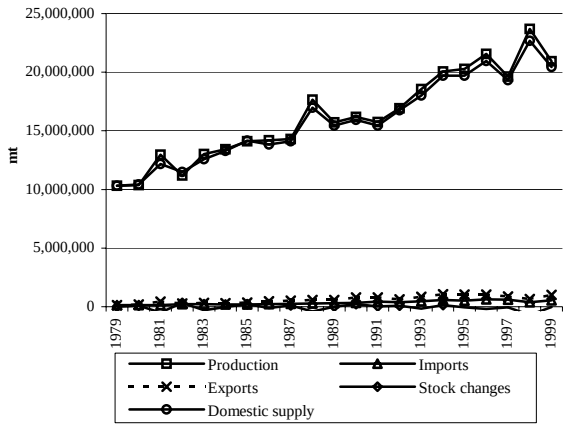
The yearly growth rate was always positive, on average +3.2 per cent, and domestic supply reached around 39 million mt in 1999, compared to 15.5 million mt in 1979 (+151 per cent).

Figure 50. Domestic supply and its components of soybean for the selected ESCAP countries



The domestic supply of groundnut increased twofold during the two last decades, reaching 20 million mt in 1999. As exports and imports remained insignificant, all increases in the domestic supply are due to increases in production, particularly yield improvements.

Figure 51. Domestic supply and its components of groundnut for the selected ESCAP countries



A similar table as for coarse grains can be created for pulses based on the various components of domestic supply. Here again five main cases can be established:

↔ Self-sufficiency: Local demand is supplied by local production. The concerned countries neither import nor do they export.

↯ Irregular importers: Significant level of production but occasionally import to meet local demand.

↓ Permanent importers: All required quantities are imported because of insufficient production or because of no local production.

↧ Surplus exporters: When the level of production (and the level of imports) is higher than the local requirement, some quantities are exported.

↑ Net exporters: Permanent quantities are exported. At the same time, some imports may occur.

Tables 29, 30, 31 illustrate the different situations and evolutions of domestic supply for each country regarding other pulses, soybean and groundnut.

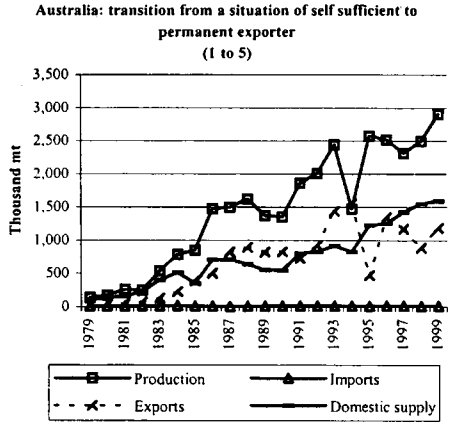
Other pulses

For most of the countries, domestic supply increased during the period. As indicated in Table 29, the number of countries becoming permanent importers multiplied by two, and represented at the end of the period 54 per cent of the countries. Only 13 per cent of the countries were self-sufficient at the end of the period, compared to 55 per cent at the beginning. Thailand is a good example of a country in transition between a self-sufficient situation and a net importer situation.

Table 29. Evolution of domestic supply of other pulses

Evolution of the domestic supply (DS) and its components	Other pulses domestic supply		
	Beginning period	End period	Evolution DS
Australia	↔	↑	increasing
Bangladesh	↔	↓	increasing
Cambodia	↔	↕	irregular
China	↔	↑	decreasing
Fiji Islands	↓	↓	increasing
India	↔	↓	increasing
Indonesia	↔	↓	increasing
Japan	↓	↓	smooth undulating
Democratic People's Rep. of Korea	↔	↔	smooth undulating
Rep. of Korea	↯	↓	increasing
Lao People's Democratic Rep.	↔	↔	increasing
Malaysia	↓	↓ ↕	increasing
Maldives	↓	↓	decreasing
Myanmar	↑	↑	increasing
Nepal	↓ ↑	↓ ↑	increasing
New Zealand	↑	↑	smooth undulating
Pakistan	↔	↓	increasing
Papua New Guinea	↔	↔	increasing
The Philippines	↔	↓	increasing
Sri Lanka	↓	↓	increasing
Thailand	↑	↑	increasing
Vanuatu	-	-	-
Viet Nam	↔	↕ ↯	increasing

Figure 52. The other pulses import/export situation of 3 contrasting ESCAP countries



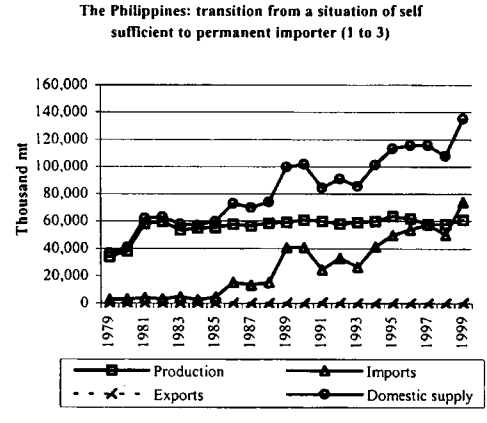


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Figure 52. The other pulses import/export situation of 3 contrasting ESCAP countries (continued)

Soybean

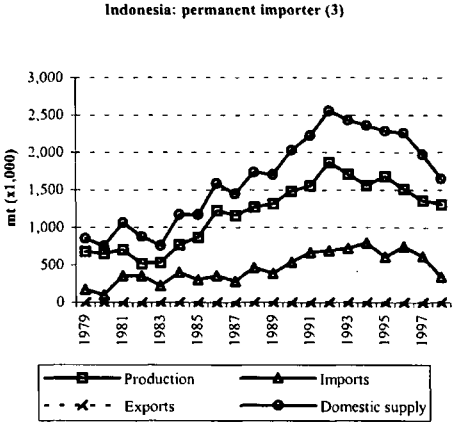
Domestic supply has mainly increased, with occasional irregular fluctuations. However, year after year, the dependence upon imports from other countries has increased, with more than 71 per cent of the countries becoming regular importers by the end of the period (compared to 53 per cent at the beginning).

The countries, which were self-sufficient at the end of the period, were India, Lao People's Democratic Republic, Myanmar and Nepal (19 per cent of the countries compared to 47 per cent in 1999).

Permanent importers include Bangladesh, Fiji Islands, Indonesia, Japan, Republic of Korea, Malaysia, New Zealand, Papua New Guinea and the Philippines.

Only Australia, China and Viet Nam have managed to export soybean.

Figure 53. The soybean import/export situation of 4 contrasting ESCAP countries



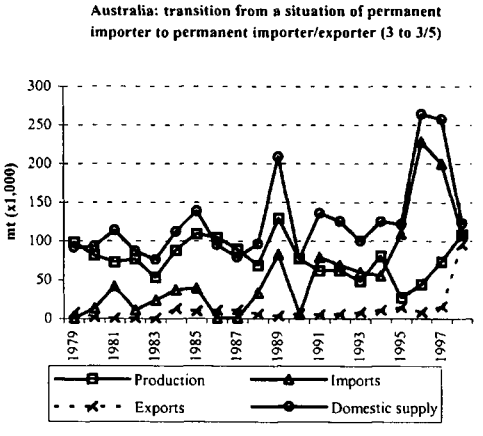


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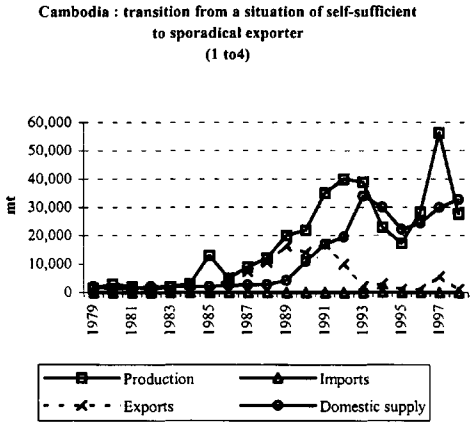
Figure 53. The soybean import/export situation of 4 contrasting ESCAP countries (continued)



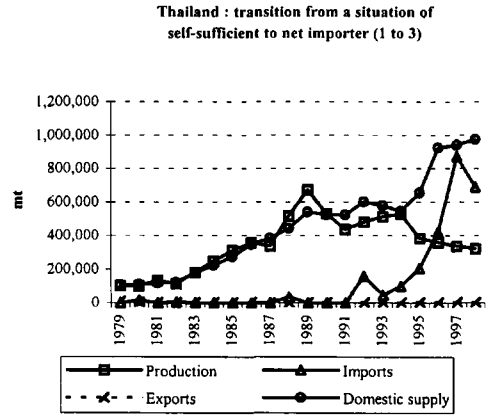


Table 30. Evolution of domestic supply of soybean

Evolution of the domestic supply (DS) and its components	Soybean domestic supply		
	Beginning period	End period	Evolution DS
Australia	↓	↓↑	increasing
Bangladesh	↓	↓	irregular/ns
Cambodia	↔	↓	increasing
China	↓↑	↓↑	increasing
Fiji Islands	↓	↓	irregular
India	↔	↔	increasing
Indonesia	↓	↓	increasing
Japan	↓	↓	stable
Democratic People's Rep. of Korea	↔	↓	irregular
Rep. of Korea	↓	↓	increasing
Lao People's Democratic Rep.	↔	↔	irregular
Malaysia	↓	↓	increasing
Maldives	-	-	-
Myanmar	↔	↔	increasing
Nepal	↔	↔	increasing
New Zealand	↓	↓	increasing
Pakistan	↔	↓	irregular
Papua New Guinea	↓	↓	increasing
The Philippines	↓	↓	increasing
Sri Lanka	↔	↓	irregular
Thailand	↔	↓	increasing
Vanuatu	-	-	-
Viet Nam	↔	↑	increasing

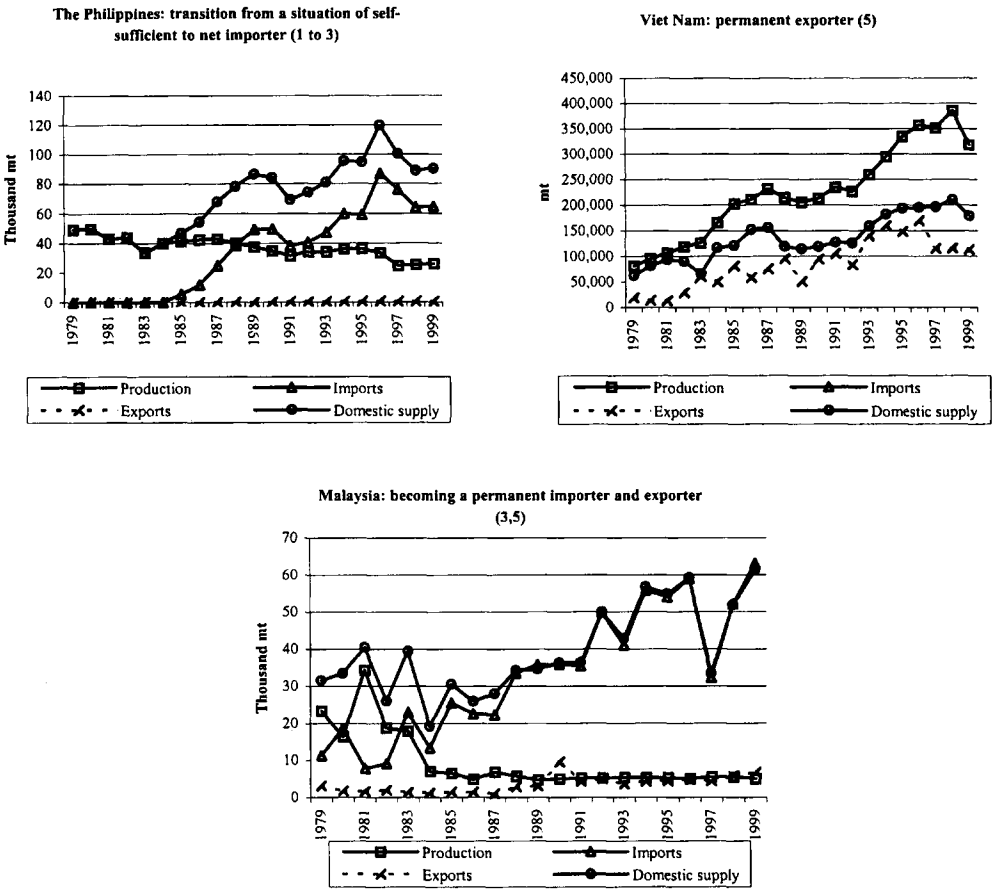
Groundnut

For most of the countries, domestic supply increased. The number of self-sufficient countries decreased significantly from 62 to 33 per cent, and the countries which had to import regularly increased by a total of 24 per cent (57 per cent at the end of the period compared to 33 per cent at the beginning). Viet Nam was a permanent exporter throughout the period. Australia, Republic of Korea and Malaysia were both regular importers and exporters at the end of the period. Fiji Islands, Japan, Nepal and Pakistan are permanent importers.

Table 31. Evolution of domestic supply of groundnut

Evolution of the domestic supply (DS) and its components	Groundnut domestic supply		
	Beginning period	End period	Evolution DS
Australia	↓↑	↓↑	irregular
Bangladesh	↔	↔	increasing
Cambodia	↔	↔	increasing
China	↔	↑	increasing
Fiji Islands	↓	↓	increasing
India	↔	↔	stabilizing
Indonesia	↔	↓	increasing
Japan	↓	↓	increasing
Democratic People's Rep. of Korea	-	-	-
Rep. of Korea	↓	↓↑	increasing
Lao People's Democratic Rep.	↔	↑	irregular
Malaysia	↓	↓↑	increasing
Maldives	-	-	-
Myanmar	↔	↔	irregular
Nepal	↓	↓	irregular
New Zealand	↓	↓	increasing
Pakistan	↔	↔	increasing
Papua New Guinea	↔	↓	stable/undulating
The Philippines	↔	↓	increasing
Sri Lanka	↔	↓	increasing
Thailand	↔↑	↔↓	stabilizing
Vanuatu	↔	↔	stable
Viet Nam	↑	↑	increasing

Figure 54. The groundnut import/export situation of 3 contrasting ESCAP countries



In summary, the evolution of domestic supply of other pulses, soybean and groundnut on a national scale showed similar evolutions:

- An increase in domestic supply for most countries.
- A decrease in the number of self-sufficient countries.
- An increase in the number of importer countries.

Table 32. Percentage of ESCAP countries becoming self-sufficient or regular importers of other pulses, soybean and groundnut

	Evolution of the percentage of self-sufficient countries from the beginning of the period to the end of the period	Evolution of the percentage of countries becoming regular importers from the beginning of the period to the end of the period
Other pulses	-41%	+27%
Soybean	-28%	+18%
Groundnut	-29%	+24%

This situation stresses a higher dependence on international markets to fulfill the requirement for domestic consumption.

Socio-economic determinants of pulse consumption

Human consumption

All pulses are mostly used for human consumption, representing yearly, on average for the period:

- 17.4 million mt of other pulses or 76 per cent of the consumption of domestic supply.
- 23 million mt of soybean or 90 per cent of the quantity of soybean domestic supply (including almost 56 per cent of high processed food).
- 14.1 million mt of groundnut, or 88 per cent of the domestic supply (59 per cent is manufactured food)

The utilization of pulses for animal feed was generally low. The share of animal feed in total domestic supply was 13 per cent for other pulses, 2.5 per cent for soybean and only 1.6 per cent for groundnut on average for the period.

The evolution of the different types of pulse consumption was quite stable during the period. A small increase in the share in animal feed can be noticed. Other pulses are not processed but the consumption of high processed soybean and manufactured groundnut was very common.

Figure 55. Share of food (manufactured and non-manufactured) utilization within the domestic supply used for the selected ESCAP countries (1979 to 1999)

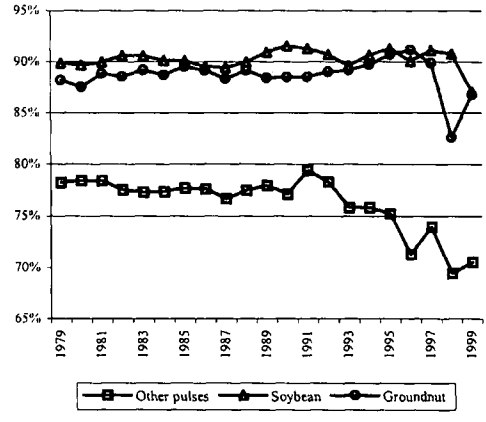
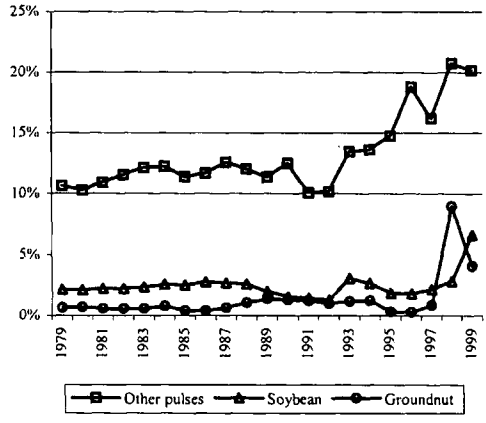


Figure 56. Share of animal feed utilization within the domestic supply used for the selected ESCAP countries (1979 to 1999)



On a national scale, regarding other pulses, all of the selected countries utilized more than 50 per cent of their domestic supply for food with the exception of a few countries mentioned in Table 33. Seventeen countries used more than 80 per cent of their domestic supply for food purposes.

Table 33. Share of animal feed utilization within total domestic supply (per cent)

	1979	1999	Average period
Other pulses			
Australia	69.8	78.7	70.8
China	15.1	54.6	26.4
New Zealand	24.9	13.8	20.5
Pakistan	13.8	14.0	13.0
India	9.4	9.0	8.3
Myanmar	0.0	35.5	7.4
Japan	3.0	3.6	3.8
Soybean			
Australia	22.5	46.9	34.3
China	2.8	7.2	11.2
Sri Lanka	10.0	10.0	10.1
Japan	1.3	2.1	1.7
Rep. of Korea	2.6	1.3	1.7

In the case of soybean, all of the countries consume their total domestic supply as (manufactured) food, except for Australia, Sri Lanka and China (and on a lesser scale Indonesia, Japan and Republic of Korea).

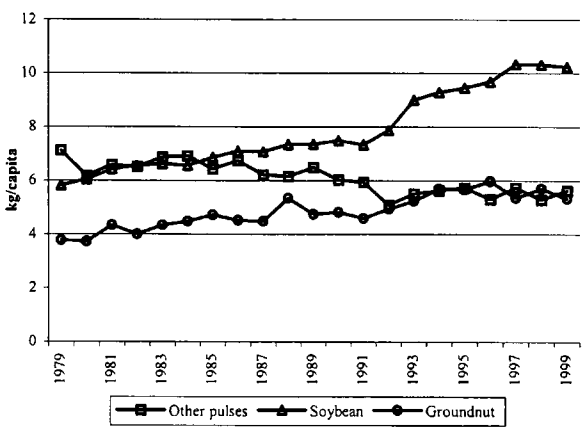
Groundnut domestic supply is consumed as human food in all of the countries studied. This may relate to the Asian crisis which caused a rise in the price of imported feed and substitution with local products.

Food consumption

The consumption of other pulses decreased slowly to 5.6 kg/capita in 1999, a decrease of 1.5 kg/capita compared to 1979.

Oppositely, soybean and groundnut consumption (food and manufactured food) registered an increase of 4.4 kg/capita and 1.5 kg/capita respectively. In 1999, the level of consumption for the region was 10.2 kg/capita for soybean and 5.3 kg/capita for groundnut.

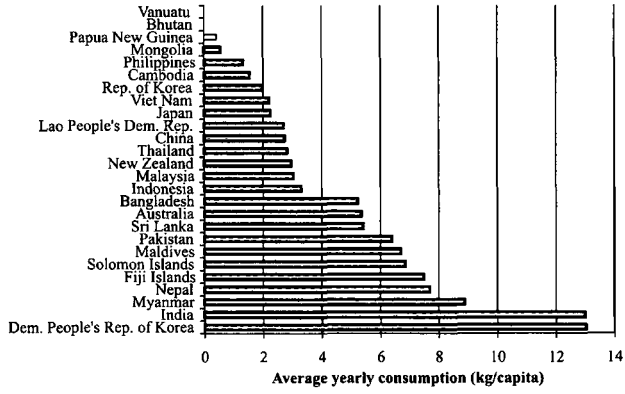
Figure 57. Average consumption (kg/capita) from 1979 to 1999 of other pulses, soybean and groundnut for the selected ESCAP countries (food and manufactured food)



However, consumption levels vary widely among countries in the region. The Democratic People's Republic of Korea and India are the largest consumers of other pulses per capita per year for the whole period with 13 kg/capita/year, followed by Myanmar (8.9 kg/capita/year), Nepal and Fiji Islands (around 7.5 kg/capita/year), and Solomon Islands and Maldives (around 6.75 kg/capita/year).

The evolution of consumption is also quite different depending upon the country. However, in general, variations are limited to either a small decrease (Thailand, Myanmar, Democratic People's Republic of Korea, India, Bangladesh, Maldives) or a small increase (Sri Lanka, China, Indonesia, Australia).

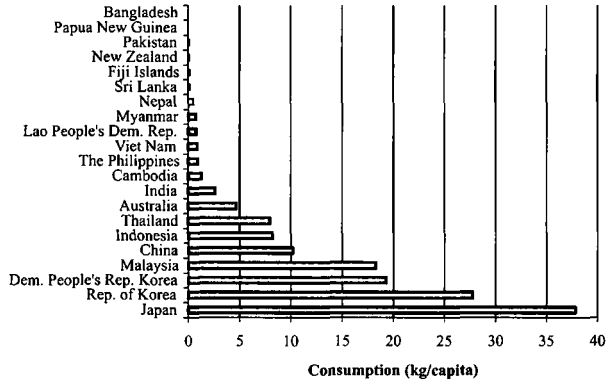
Figure 58. Yearly average consumption (food; kg/capita; 1979-1999) of other pulses for the selected ESCAP countries



Japan and the Republic of Korea are the main soybean consumers with more than 37 kg and 27 kg consumed per capita per year respectively. Three countries, Democratic People's Republic of Korea, Malaysia and China consume more than 10 kg/capita of soybean per year. Indonesian and Thai people consume around 8 kg/year/capita and all the other countries have consumption figures of less than 5 kg/year/capita.

The consumption level has increased in almost all of the countries.

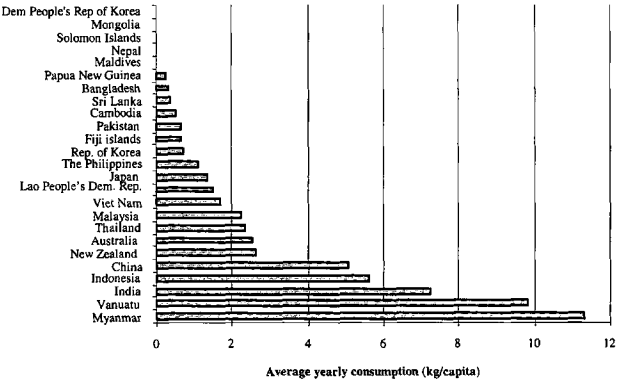
Figure 59. Yearly average consumption (food; kg/capita; 1979-1999) of soybean for the selected ESCAP countries



In terms of consumption per capita, Myanmar and Vanuatu were the largest consumers of groundnut for the period, with on average 11.3 and 9.8 kg/capita/year respectively, followed by India and Indonesia, with 7.2 and 5.6 kg/capita/year respectively.

The global consumption trend shows a small increase (China, the Philippines, Indonesia, Fiji Islands) or a stable situation/smooth variations, except for Vanuatu, where the consumption level decreased by 3 kg/capita/year from 1979 to 1999.

Figure 60. Yearly average consumption (food; kg/capita; 1979-1999) of groundnut for the selected ESCAP countries



Consumption patterns

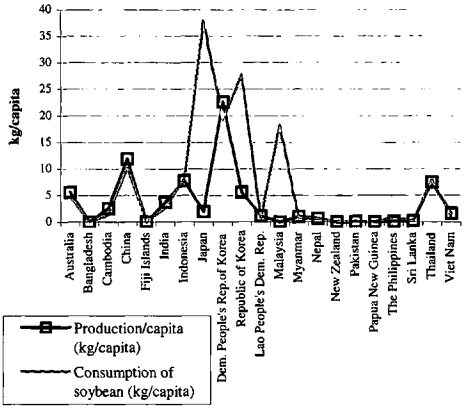
Most of the domestic supply of other pulses, soybean and groundnut is consumed to satisfy human food requirements. Consumption habits therefore, consequently drastically influence the trend of these crops, regarding production, imports, exports and utilization. The importance of the impact of food habits compared to other socio-economic indicators of the country should not be overlooked.

For other pulses and groundnut, no relationship was found between the consumption level of other pulses, groundnut and the level of production/trade, percentage of rural population, or HDI.

For soybean, the only clear relation between the level of production and the level of consumption of soybean relates to huge imports, a rather logical fact.

No relationship was found between socio-economic indicators such as rural/urban population, level of income, etc. and consumption of soybean as food.

Figure 61. Consumption and production of soybean (kg/capita) on average for the period by the selected ESCAP countries



The case of soybean oil

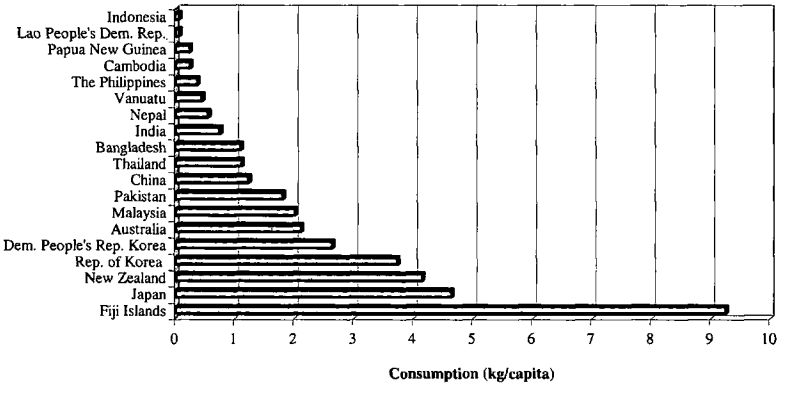
Soybean oil is processed mainly in three countries, China, Japan and India. They together produce 89 per cent of the region's soybean oil. Even though the price of soybean oil decreased (falling to 335 US$/million mt for crude oil, FOB ex mill in 2000), production still increased by a multiple of 2.7 in 20 years reaching 3.6 million mt in 2000.

Exports were less significant (less than 4 per cent of production) than imports (more than 60 per cent) and reached 3.1 million mt in 1999.

Due to high imports, domestic supply in the region reached 6 million mt in 2000. Per capita per year, Fiji Islands is the main consumer with more than 9 kg/capita/year on average (entire quantity imported). Japan and New Zealand, with respectively 3.6 and 3.1 kg/capita/year are far behind.

Consumption is irregular from one year to another, but the general trend is towards a small increase (with the exception of Malaysia).

Figure 62. Consumption (kg/capita; 1979-1999) of soybean oil by the selected ESCAP countries



As a by-product of oil extraction, the cakes of soybean (oilcakes and other residues, except dregs), whether or not ground, or in the form of pellets, represent a significant output in countries producing soybean oil. The production of soybean cake has continuously increased during the last two decades; starting at 6 million mt and reaching 17.3 million mt. China, India and Japan are the main producers.

Countries consuming soybean oil have experienced a significant level of development. Indeed, it can be noticed – for these countries - a correlation between:

- The share of rural population and soybean oil consumption (kg/capita):

  The smaller the rural population, the higher the consumption of oil. Excluding the Fiji Islands, the coefficient of correlation between all consumer countries and the percentage of rural population was - 0.83. Countries for which the share of rural population is below 30 per cent (Republic of Korea, Japan, New Zealand and Australia) are, after the Fiji Islands, the main consumers of soybean oil. The countries with low soybean oil consumption (Vanuatu, Nepal, Papua New Guinea, Cambodia, Lao People's Democratic Republic, Viet Nam and, Sri Lanka) have a share of rural population close to 80 per cent or more.

- The Human Development Index (HDI) and the soybean oil consumption level (kg/capita):
  The higher the HDI, the higher the consumption of soybean oil. A 0.68 coefficient of correlation was found between HDI value and soybean oil consumption (excluding the Fiji Islands).

Figure 63. Correlation between the percentage of rural population and consumption of soybean oil (kg/capita/year) for the selected ESCAP countries (average 1979-1999)

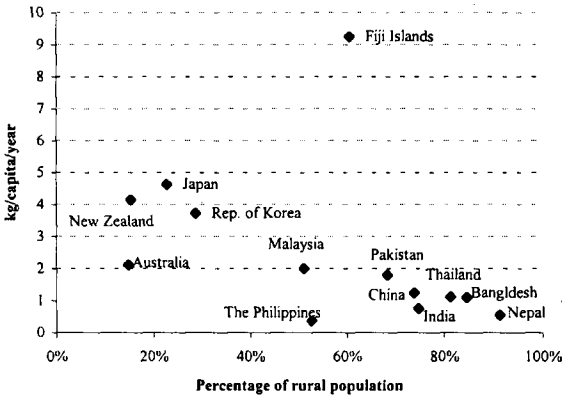
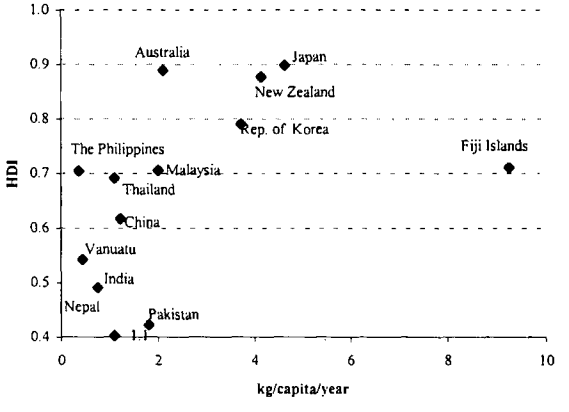


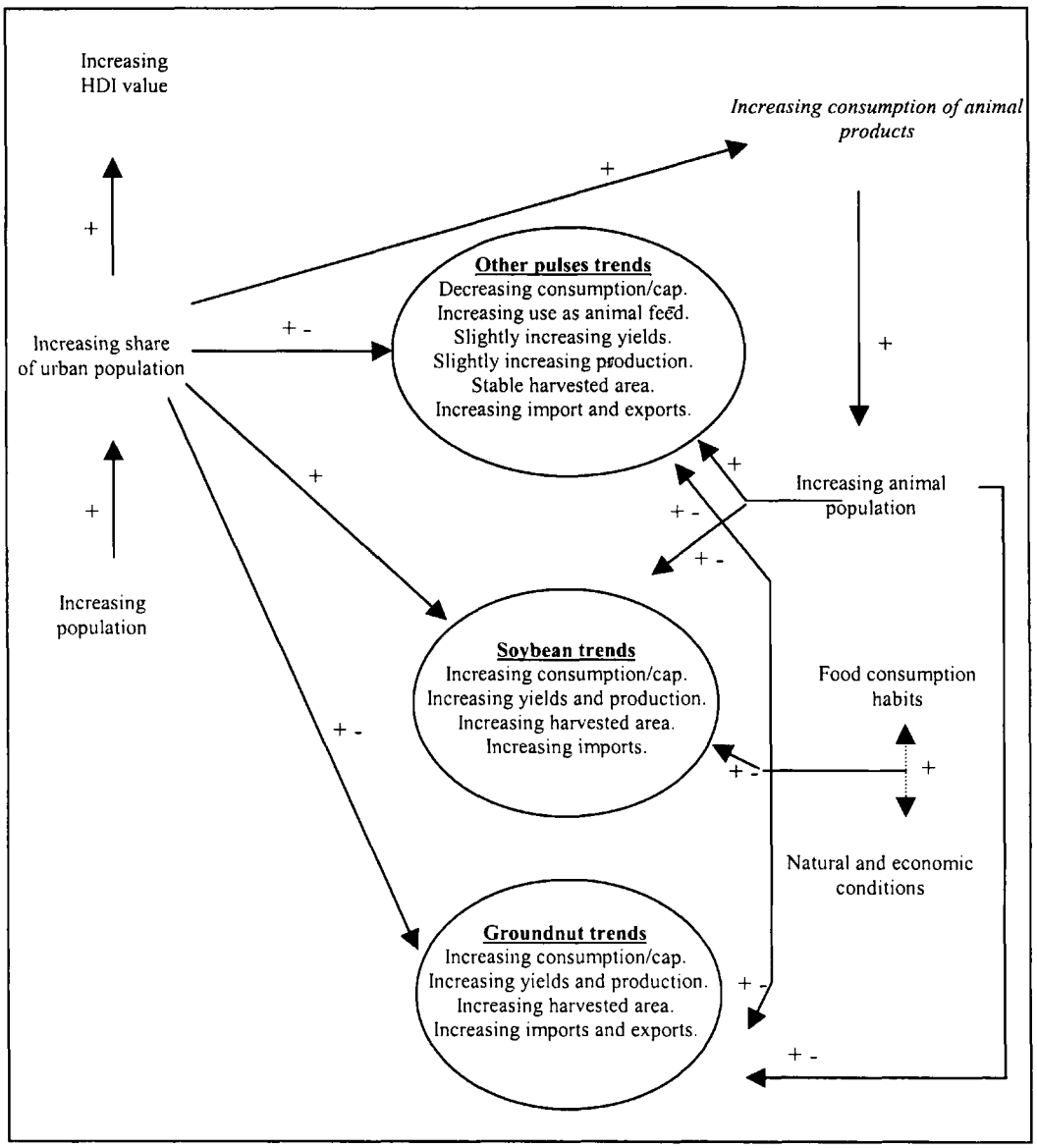
Figure 64. Correlation between HDI and consumption of soybean oil (kg/capita/year) for the selected ESCAP countries (average 1979-1999)



Conclusion: Future development of pulses in the region

According to these results, variables, qualitative and quantitative, which might influence different aspects of pulse development in the region, are summarised in Figure 65.

Figure 65. Flow chart to show the influencing factors to other pulses, soybean and groundnut trends

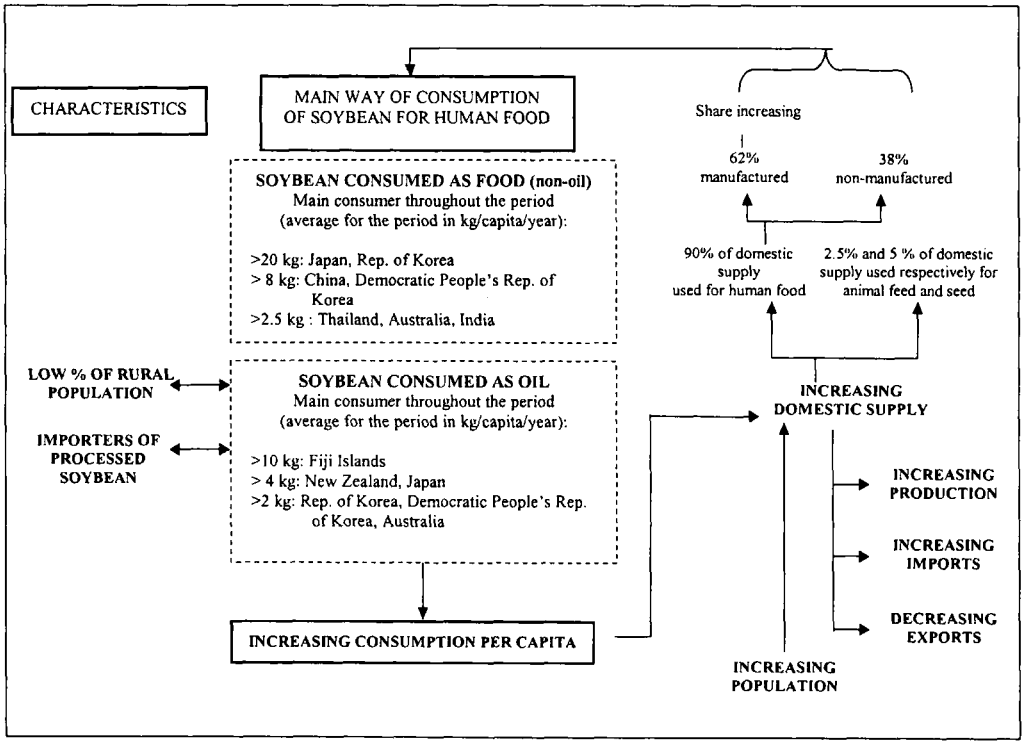


No clear domestic consumption patterns among countries arise from this analysis besides the fact that China and India are the main producing and consuming countries, a fact that is strongly related to the size of the country and their population. In terms of exports, China is the major actor for all pulses (with Australia for other pulses). Regional groundnut and other pulses exports exceed regional imports (India for other pulses and Japan/Indonesia for groundnut). In the case of soybean, regional needs (Japan and China mainly) are satisfied through imports from outside the region.

Soybean thus becomes the major strategic commodity for the region within the pulses group. In Figure 66, the current trends in soybean consumption and trade are displayed. It looks

like – regarding the situation of some significant consumers (China, India, Indonesia, Japan) – soybean consumption as food and oil will continue to increase slowly or stabilize. As consumption in China and Japan stabilizes (with fluctuations for China), consumption in India and Indonesia becomes key for the future.

Figure 66. General trend of soybean for different components (harvested area, yield, production, trade, processing) from 1980 to 2000 in Asia and the Pacific regarding social and economical indicators



Part IV
Root and Tuber Crops

Importance of root and tuber crops

The root and tuber crops group

Roots and tubers, according to FAO, are plants yielding starchy roots, tubers, rhizomes, corms and stems. The denomination roots and tubers excludes crops that are cultivated mainly for feed, for sugar production and those classified as "roots, bulb and tuberous vegetables" (onions, garlic and beets). It includes starch and the starchy pith and flour obtained from the trunk of the sago palm and the stem of the Abyssinian banana (Musa ensete).

Some root crops, notably bitter cassava, contain toxic substances, particularly in the skins. As a result, some processes must be undertaken to make the product safe for human consumption. Apart from their high water content (70-80 per cent), these crops contain mainly carbohydrates (largely starches that account for 16-24 per cent of the total weight) with very little protein or fat.

Roots and tubers are used mainly for human food (as is or in processed form), for animal feed and for manufacturing starch, alcohol and fermented beverages, including beer. They play an important role in feeding both poor and remote populations, as well as in increasing the income of farmers, especially as cassava is one of the most commonly marketed commodities.

Potatoes are grown in temperate zones. They can be processed into flour, meal, flakes, granules and pellets, frozen potatoes, starch and tapioca.

Sweet potatoes are grown in tropical and subtropical regions. They are used mainly for human food. The trade data covers fresh and dried tubers, whether or not sliced or in the form of pellets.

Cassava is a semi-permanent crop grown in tropical and subtropical regions. Sometimes bitter and sweet cassavas are referred to as separate species, the former being Manioc esculenta and the latter Manioc palmata, but this is incorrect since the toxicity varies according to location. Cassava is a staple food in many tropical countries. It is not traded internationally in its fresh state because tubers deteriorate very rapidly. Cassava may be processed into flour (peeled, dried and milled, mainly for human consumption), tapioca (used in the preparation of puddings and in infant foods), dried cassava (includes peeled, sliced and sun-dried cassava chips, as well as ground and compressed cassava pellets, used mainly as livestock feed), and starch (it is the principal industrial form of cassava and it is used in the foodstuff, textile and paper industries for the manufacture of plywood veneer, adhesives, glucose and dextrin).

Taro is cultivated for its edible starchy corms or underground stems. Taro is grown throughout the tropics for food. Trade data covers both fresh and dried taro. The principal edible yams are widely grown throughout the tropics. A starchy staple foodstuff, normally eaten as a vegetable, boiled, baked or fried.

This chapter on root and tuber crops focuses on the three major crops found in Asia and the Pacific, namely potato, sweet potato and cassava. Whenever required, additional data regarding the roots and tubers group as a whole is presented.

Asian and Pacific root and tuber crops in the world

Asian and Pacific countries provide respectively 40 and 35 per cent of world production[1] and harvested area of roots and tubers (1979-1999). Asian and Pacific cassava exports, sweet potato harvested area and production in the selected ESCAP countries occupies a predominant position on a world scale, while potato trade remains marginal.

Table 34. Distribution of roots and tubers (per cent)

Share of Asia and the Pacific within the world		Roots and tubers (total)	Potato	Sweet potato	Cassava
Production	1979	38	15	94	34
	Average	40	22	93	33
	1999	42	31	92	27
Harvested area	1979	38	19	88	27
	Average	35	25	82	25
	1999	33	33	5	21
Imports	1979		4	0	24
	Average		9	13	15
	1999		13	44	24
Exports	1979		3	36	86
	Average		3	8	92
	1999		2	36	87

The harvested area of roots and tubers in Asia and the Pacific is quite stable and represents around 13 per cent of the total CGPRT crop area in the region. The production of roots and tubers has increased significantly in 20 years to reach around 28 million mt in 2000, as indicated in Figure 68.

Figure 67. Evolution of the harvested area (1979-2000) of roots and tubers and other CGPRT crops (pulses, soybean, coarse grains) in the selected ESCAP countries from 1979 to 2000

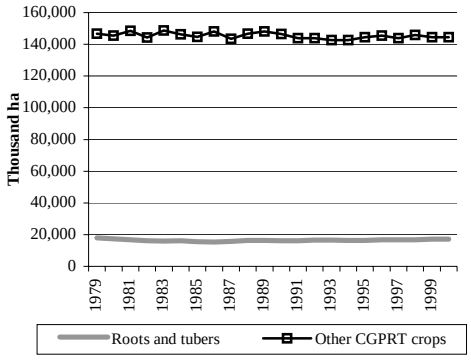
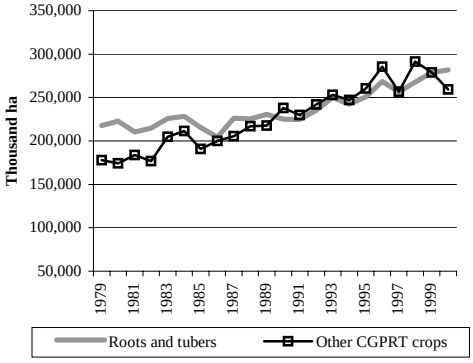


Figure 68. Evolution of the production (1979-2000) of roots and tubers and other CGPRT crops (pulses, soybean, coarse grains) in the selected ESCAP countries from 1979 to 2000



[1] Production data of root crops is reported in terms of clean weight, i.e. free of earth and mud. In Asia and the Pacific, one may distinguish primary root and tuber crops, namely potato, sweet potato, cassava, taro, yams and roots from tubers nes (a small and less important group of several crops).

Roots and tubers represent 31 per cent of the total export value of CGPRT crops, mainly due to cassava exports. The share of roots and tubers in imports is marginal, around 2 per cent and therefore, the region as a whole is a net exporter of roots and tubers.

Figure 69. Distribution of imports in value (period 1979-1999)

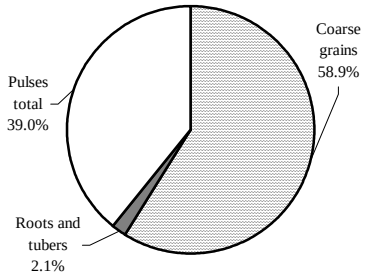
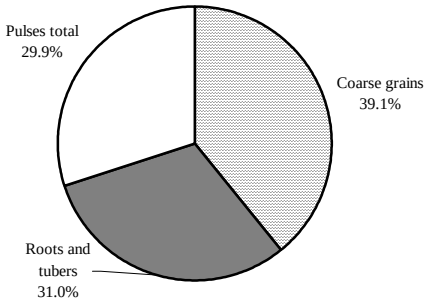


Figure 70. Distribution of exports in value (period 1979-1999)



Yields boost domestic supply

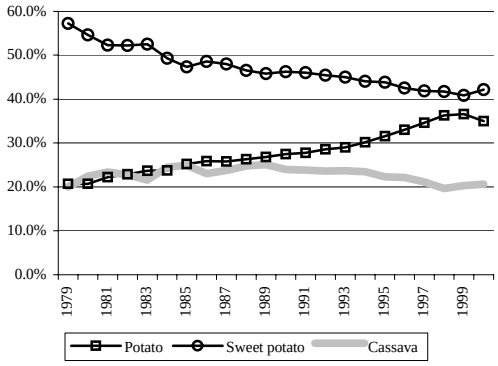
Variations in area, increasing yields

Area

After a decrease of about two million ha from 1983 to 1987, the harvested area of roots and tubers for the selected ESCAP countries in 2000 reached the 1980 level, close to 17.3 million ha. However, the evolution of area by crop shows different situations:

- ➔ A stabilization of the cassava area: The harvested area only varied from 3.5 million ha to 4 million ha during the last twenty years (+14 per cent).
- ↗ A regular increase in potato harvested area during the last two decades, from 3.7 million ha to more than 5.9 million ha (+60 per cent).
- ↘ A regular decrease in sweet potato harvested area from 10.2 million ha to 7.2 million ha (-30 per cent).

Figure 71. Evolution of the share of potato, sweet potato and cassava within roots and tubers harvested area



Over the last twenty years significant changes in root and tuber land allocation have appeared. The share of sweet potato evolved from 57 to 42 per cent by 1999. The situation remained stable for cassava, taro and roots and tubers nes, however, potato area saw its share increase from 20.7 per cent (1979) to around 35 per cent in 1999.

As indicated in Table 35, most of the countries experienced an increase in potato harvested area and a decrease in sweet potato harvested area. Forty per cent of the countries studied were not producers of cassava.

Table 35. Evolution of the harvested area of potato, sweet potato and cassava, 1979-1999

Evolution of harvested area (1979 – 1999)	Not grower	Stable	Increasing	Decreasing	Smooth variation	Irregular
Potato	Cambodia, Malaysia, Maldives, Vanuatu, Solomon Islands	Australia, the Philippines, Lao People's Democratic Republic, Papua New Guinea	Bangladesh, Nepal, Pakistan, Indonesia, Myanmar, China, New Zealand, India, Thailand, Bhutan,	Viet Nam, Japan, Fiji Islands		Rep. of Korea, Democratic People's Rep. of Korea, Mongolia, Sri Lanka
Sweet potato	Vanuatu, Nepal, Mongolia, Bhutan	Myanmar	Papua New Guinea, Democratic People's Rep. of Korea, Solomon Islands, Australia,	China, Viet Nam, India, Indonesia, the Philippines, Rep. of Korea, Bangladesh, Japan, Sri Lanka, Thailand	Malaysia	Lao People's Democratic Republic, Cambodia, New Zealand, Fiji Islands, Pakistan, Maldives
Cassava	Australia, Bangladesh, Bhutan, Japan, Democratic People's Rep. of Korea, Rep. of Korea, Nepal, Vanuatu, New Zealand, Pakistan	China, Lao People's Democratic Republic, Maldives	The Philippines, Malaysia, Myanmar, Solomon Islands	Viet Nam, India, Sri Lanka	Indonesia	Thailand, Cambodia, Fiji Islands

Yield

For potato, sweet potato and cassava, the selected ESCAP countries experienced, on average, a significant increase in their yield, as indicated in Table 36.

Sweet potato yields registered the highest increase (+41.5 per cent in 21 years), followed by potato (+40.4 per cent) and then cassava (+23.3 per cent).

Depending upon the country, important differences can be observed. A significant number of countries experienced a decrease in their yields. Countries with the highest yield progression include more developed countries (Australia, New Zealand, Republic of Korea).

Figure 72. Yield of potato, sweet potato and cassava from 1979 to 1999 for the selected ESCAP countries

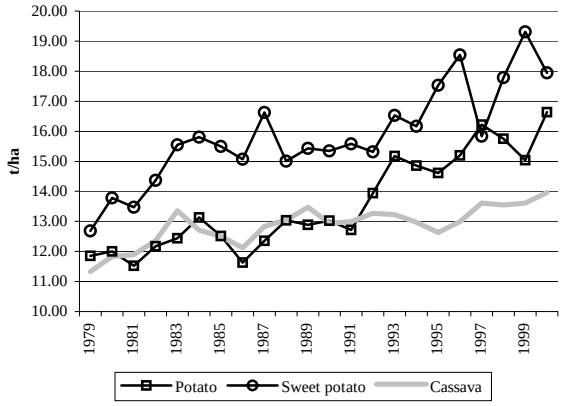


Table 36. Evolution of average yield of potato, sweet potato and cassava, 1979-1999

(Average yield period 1996 to 2000) – (Average yield period 1979 to 1984) t/ha	Decreasing	Yield gain (ton/ha)			
		< 2	[2; 5]	[5; 10]	> 10
Potato	Mongolia, Lao People's Democratic Republic, Papua New Guinea, Democratic People's Rep. of Korea, Thailand	Myanmar, Sri Lanka, Bangladesh	India, China, Pakistan, Japan, the Philippines, Nepal, Viet Nam	Australia, Indonesia, Bhutan, Fiji Islands	New Zealand, Rep. of Korea
Sweet potato	Myanmar, the Philippines, Lao People's Democratic Republic, Democratic People's Rep. of Korea, Rep. of Korea, Bangladesh, Cambodia, Pakistan, Sri Lanka	Indonesia, India, Viet Nam, Maldives, Papua New Guinea, Malaysia	Solomon Islands, New Zealand, China, Japan	Australia, Fiji Islands, Thailand	
Cassava		Viet Nam, Papua New Guinea, Cambodia, China, Maldives	Indonesia, Solomon Islands	India	

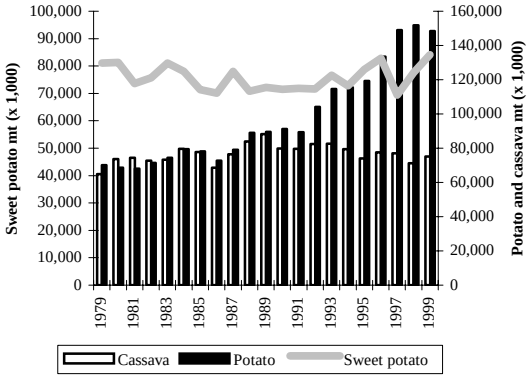
Production

As a result of harvested area evolution and increasing yields, potato production has increased in the region, while sweet potato and cassava production has remained stable.

Total production of roots and tubers has increased by around 61 million mt in 20 years, reaching 278 million mt in 1999.

Potato acreage has more than doubled in 20 years, which has logically induced a production increase. Production has more than doubled, reaching more than 92.5 million mt in 1999 (compared to 43.8 million mt in 1979).

Figure 73. Production of potato, sweet potato and cassava in selected ESCAP countries



Sweet potato production, in spite of a decrease in harvested area, fluctuated only a little during the said period due to higher yields. The highest level of production was registered in 1999, with 134.5 million mt, at which time the harvested area was the smallest for the period.

Average yearly production of cassava for the selected ESCAP countries has been at around 48 million mt during the last twenty years. Starting at 40 million mt, production increased regularly until 1989 where it reached a peak (55 million mt), after which it decreased to a level of 47 million mt in 1999.

The countries have evolved in different ways. Regarding potato and sweet potato, more than one quarter of the countries experienced irregular production.

Table 37. Evolution of the production of potato, sweet potato and cassava, 1979-1999

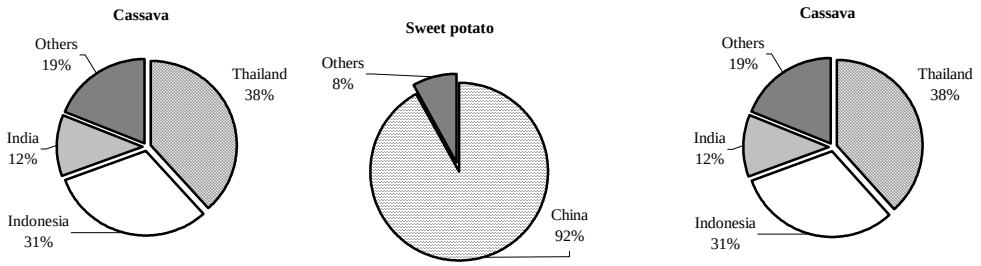
Evolution of the production (1979 to 1999)	Not grower	Stable	Increasing	Decreasing	Smooth variation	Irregular
Potato	Cambodia, Malaysia, Maldives, Vanuatu, Solomon Islands		China, India, Bangladesh, Australia, Pakistan, Nepal, Myanmar, New Zealand, Indonesia, the Philippines, Papua New Guinea	Japan	Lao People's Democratic Republic	Democratic People's Rep. of Korea, Rep. of Korea, Viet Nam, Mongolia, Sri Lanka, Thailand, Fiji Islands
Sweet potato	Mongolia, Nepal, Vanuatu, Bhutan	Papua New Guinea, Myanmar	Solomon Islands, New Zealand Australia, Fiji Islands	Japan, India, the Philippines, Rep. of Korea, Thailand, Sri Lanka	China, Malaysia	Viet Nam, Lao People's Democratic Republic, Indonesia, Democratic People's Rep. of Korea, Cambodia, Pakistan, Maldives
Cassava	Australia, Bangladesh, Bhutan, Japan, Democratic People's Rep. of Korea, Rep. of Korea, Nepal, Vanuatu, New Zealand, Pakistan	Papua New Guinea, Lao People's Democratic Republic	Indonesia, Malaysia Solomon Islands, Maldives	Viet Nam, Sri Lanka	The Philippines, China	Thailand, India, Cambodia, Myanmar, Fiji Islands

Producers

Regarding potato, China contributes 60 per cent of regional production, followed by India with 24 per cent. At the same time, China accounts for more than 90 per cent of the region's total sweet potato production.

The main producers of cassava are Thailand and Indonesia, for which the share for the period is respectively around 38 per cent (18 million mt/year) and 31 per cent (15 million mt/year). India follows with, on average for the period, 5.5 million mt/year (12 per cent).

Figure 74. Distribution of the production of potato, sweet potato and cassava per country (average 1979-1999)

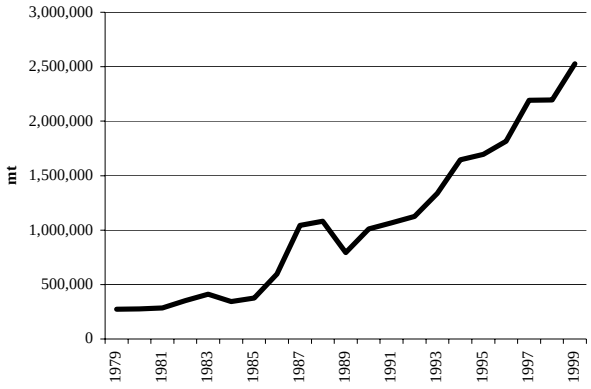


Contrasting trade patterns

Increasing imports

Potato imports have increased tenfold in twenty years, especially since 1985, reaching 2.5 million mt in 2000. However, imports have never exceeded 3 per cent of total domestic production. Almost all of the countries studied imported increasing or irregular quantities (with the exception of Lao People's Democratic Republic and Myanmar).

Figure 75. Imports of potato to the selected ESCAP countries



Imports of sweet potato are very limited and irregular. Starting in 1979 with less than 0.5 million mt, imports of cassava (dry equivalent) increased continuously but erratically up to almost 5 million mt in 1999, with an average for the period of 3.7 million mt. Cassava imports represent on average 7.5 per cent of the level of production of the selected ESCAP countries,

oscillating between 1 per cent in 1979, 13.5 per cent in 1990 and 10 per cent in 1999. Around one third of the countries were not importers. The others experienced irregular or increasing imported quantities.

Figure 76. Imports of cassava to the selected ESCAP countries

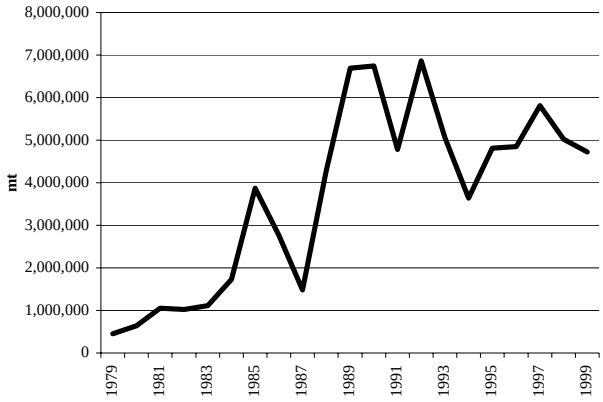


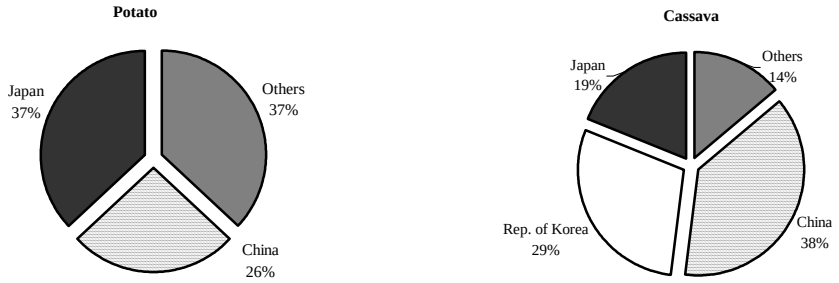
Table 38. Evolution of potato and cassava imports, 1979- 1999

Evolution of imports (1979- 1999)	None	Increasing	Irregular
Potato	Lao People's Democratic Republic, Myanmar	Rep. of Korea, China, Japan, Malaysia, Thailand, Sri Lanka, Indonesia, Thailand, the Philippines, Australia, New Zealand, Pakistan, Fiji Islands, Maldives, Vanuatu, India, Cambodia	Democratic People's Rep. of Korea, Mongolia, Papua New Guinea, Bangladesh, Solomon Islands
Cassava	Bhutan, Cambodia, Lao People's Democratic Republic, Viet Nam, Maldives, Mongolia, Myanmar, Vanuatu, Solomon Islands	Australia, Bangladesh, China, Malaysia, India, Sri Lanka, Bangladesh, Pakistan, New Zealand	Fiji Islands, India, Japan, Democratic People's Rep. of Korea, Indonesia, the Philippines, Democratic People's Rep. of Korea, Thailand

The main importers of potato and sweet potato are Japan (36 and 43 per cent respectively) and China (26 and 27 per cent respectively).

Regarding cassava, China, Republic of Korea and Japan represent more than 86 per cent of the region's imports.

Figure 77. Distribution of the imports of potato and cassava (average 1979-1999)

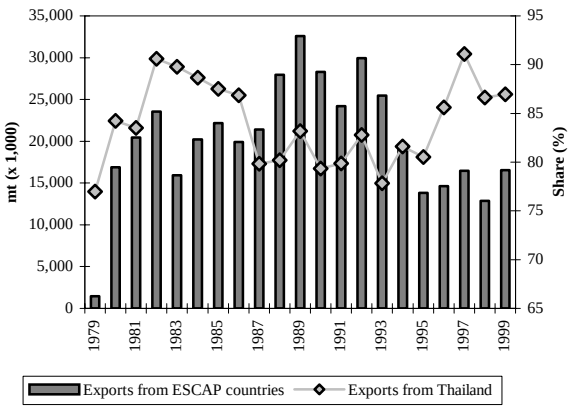


Exports

Cassava is the only significant export crop in Asia and the Pacific from the root and tuber crop group (Appendix 4). Yearly exports of potato and sweet potato are irregular. They represent only 0.5 per cent of domestic production and are dominated by China with respectively 40 per cent and 98 per cent of the region's exports.

Conversely, cassava exports account for 43 per cent of the quantity produced in the region. However, the trend is not regular. Starting at 14 million mt in 1979, exports steadily increased to double by 1990, and then decreased in an irregular way to reach 16.5 million mt in 1999. Thailand dominates cassava trade with an 84 per cent share of the volume exported.

Figure 78. Exports of cassava (1979-1999) from the selected ESCAP countries and Thailand's share



The situation among the selected countries was mostly irregular.

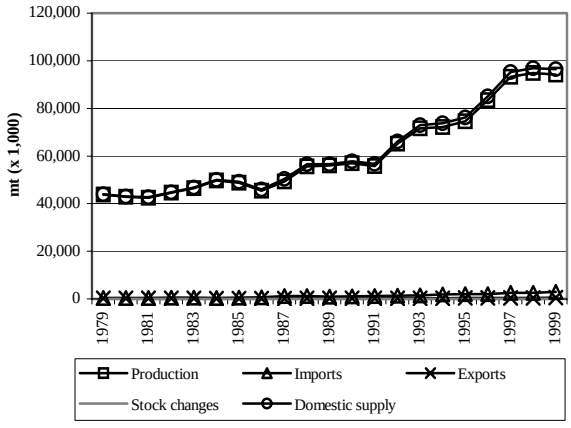
Table 39. Evolution of cassava, potato and sweet potato exports, 1979-1999

Evolution of exports (1979 –1999)	None	Increasing	Decreasing	Irregular
Cassava	Bangladesh, Cambodia, Democratic People's Rep. of Korea, Lao People's Democratic Republic, Maldives, Mongolia, Myanmar, Nepal, New Zealand, Papua New Guinea, Vanuatu, Solomon Islands	Viet Nam, Japan		Thailand, Indonesia, China, India, Malaysia, the Philippines, Pakistan, Fiji Islands, Rep. of Korea, Australia
Potato	Myanmar, Lao People's Democratic Republic, Maldives, Mongolia, Papua New Guinea, Solomon Islands, Vanuatu	New Zealand, Australia, Rep. of Korea	(Cambodia)	China, Indonesia, India, Pakistan, Malaysia, Thailand, Democratic People's Rep. of Korea, Japan, Nepal, Bangladesh, Viet Nam, the Philippines, Sri Lanka, Fiji Islands
Sweet potato	Cambodia, Democratic People's Rep. of Korea, Maldives, Lao People's Democratic Republic, Nepal, Mongolia, Myanmar, Papua New Guinea, Solomon Islands, Sri Lanka, Vanuatu, Viet Nam, (Pakistan, Bangladesh, Australia, Fiji Islands, the Philippines)	China, Indonesia, Malaysia, India		Japan, Thailand, Rep. of Korea, Bangladesh, Thailand

The rise in domestic supply

Regarding potato, domestic supply has shown a significant increase from 43.9 million mt in 1979 to around 95 million mt in 1999. As exports and changes in stock levels were not very significant relative to the level of production, domestic supply was mostly influenced by domestic production through a combination of cultivated area expansion and better yields.

Figure 79. Domestic supply and its components of potato for the selected ESCAP countries (1979-1999)



For sweet potato, as trade (exports, imports) has been almost non existent, domestic supply is nearly equal to the level of production and has remained stable throughout the period in spite of a reduction in cultivated area. This is due to improvements in yield.

Domestic supply of cassava in the selected ESCAP countries reached 35 million mt in 1999, which is an increase of around 27 per cent compared to the level registered in 1979. The level of the region's cassava production has always been above the region's domestic requirement, which allowed the region to be a net exporter, even if, since the last decade, the difference (mt) between these two levels is narrowing.

Figure 80. Domestic supply and its components of sweet potato for the selected ESCAP countries (1979-1999)

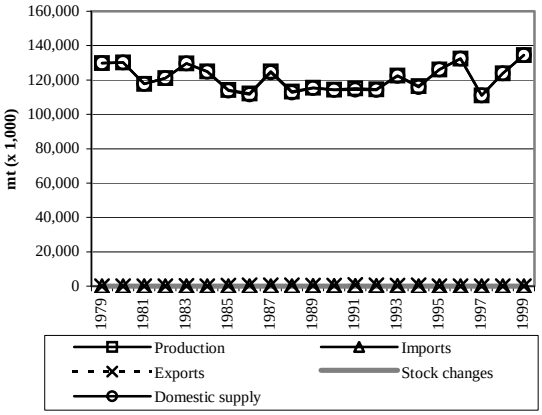
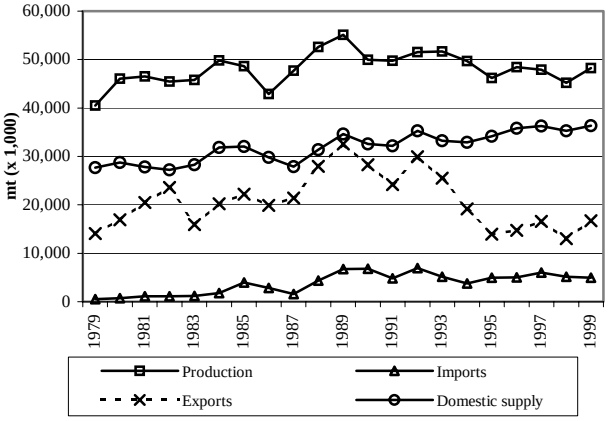


Figure 81. Domestic supply and its component of cassava for the selected ESCAP countries (1979-1999)



As was applied to coarse grains and pulses beforehand, Table 40 presents the situation of the selected countries with regard to how they constitute their domestic supply. Since for potato and sweet potato, most of the production is consumed within the country of origin and exports and imports remain almost non-significant compared to the level of production, only cassava is displayed in the table. Again, five main patterns can be established:

↔ Self-sufficiency: Local demand is supplied by local production. The concerned countries (Cambodia, Fiji Islands, India, Lao People's Democratic Republic, Myanmar, Papua New Guinea) that neither import nor do they export.

↯ Irregular importers: Significant level of production but occasionally import quantities to meet local demand.

↓ Permanent importers: All required quantities are imported because of insufficient production or because of the absence of local production (Bangladesh, both Koreas, Japan, Pakistan).

↑̄ Surplus exporters: When the level of production (and the level of imports) is higher than the local demand, some quantities are exported (Sri Lanka).

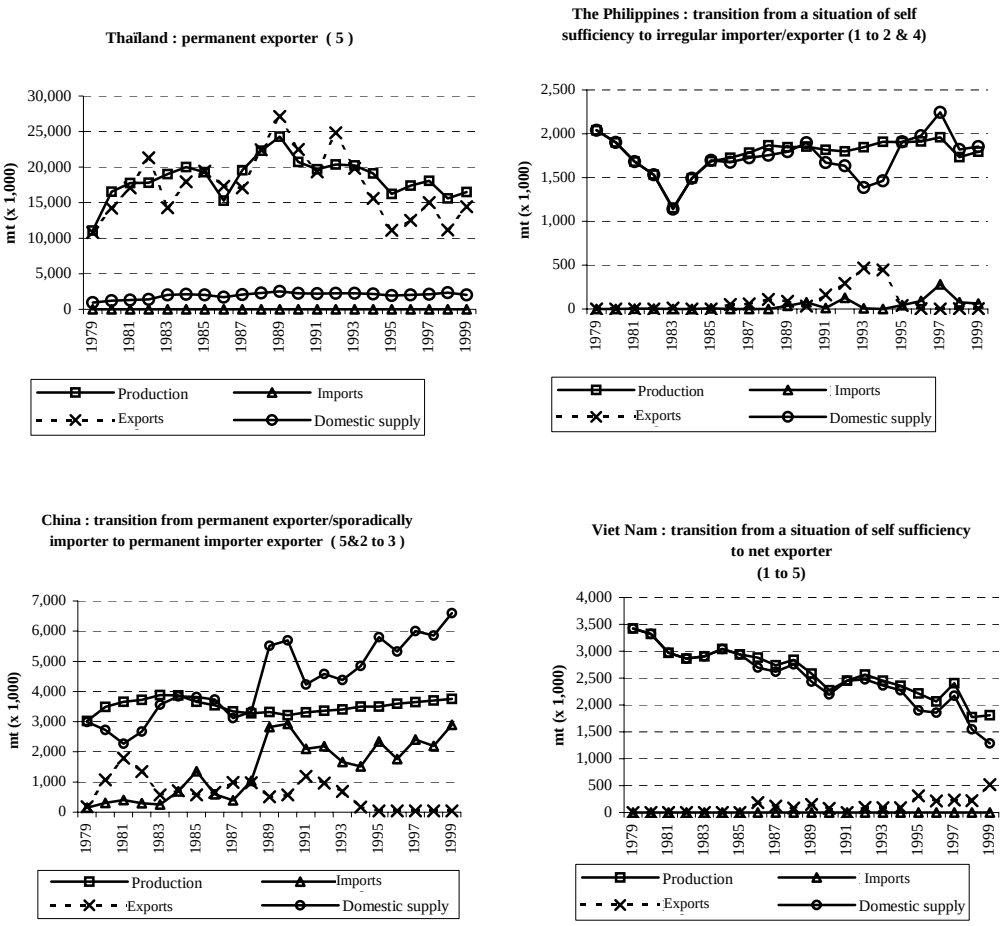
↑ Net exporters: Permanent quantities are exported. At the same time, some quantities may be imported (Indonesia, Thailand, Viet Nam).

Table 40. Evolution of cassava domestic supply

Evolution of the domestic supply (DS) and its components	Cassava domestic supply		
	Beginning period	End period	Evolution DS
Australia	-	↓	increasing
Bangladesh	↓	↓	increasing
Cambodia	↔	↔	irregular
China	↑↯	↓	increasing
Fiji Islands	↔	↔	irregular
India	↔	↔	undulating/stable
Indonesia	↑	↑	increasing
Japan	↓	↓	irregular
Democratic People's Rep. of Korea	↓	↓	irregular
Rep. of Korea	↓	↓	irregular
Lao People's Democratic Republic	↔	↔	irregular
Malaysia	↑̄	↓	increasing
Maldives	-	-	-
Myanmar	↔	↔	Irregular
Nepal	-	-	
New Zealand	-	↓	irregular
Pakistan	↓	↓	increasing
Papua New Guinea	↔	↔	increasing
The Philippines	↑	↯↑̄	irregular
Sri Lanka	↔	↑̄	decreasing
Thailand	↑	↑	small increasing
Vanuatu	-	-	
Viet Nam	↔	↑	decreasing

Figure 82 illustrates some of the different transition situations observed.

Figure 82. The import/export situation for roots and tubers of 4 contrasting ESCAP countries



The percentage of importing countries increased from 25 per cent to 33 per cent over the period. While almost half of the countries were self-sufficient at the beginning of the period, only one third remained so at the end. For all of the countries, with the exception of Sri Lanka and Thailand, domestic supply increased and/or was irregular.

Socio-economic determinants of root and tuber crop consumption

Consumption

Root and tuber crops are mainly consumed as food. However, the level of the share and its evolution shows differences amongst the crops, especially when looking at the share of quantities used as animal feed and manufactured food.

Figure 83. Share of food utilization within the domestic supply of the selected ESCAP countries

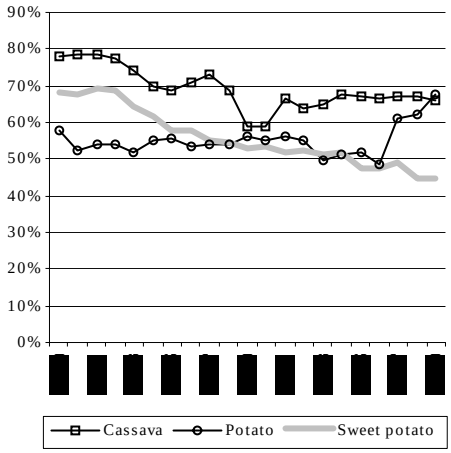
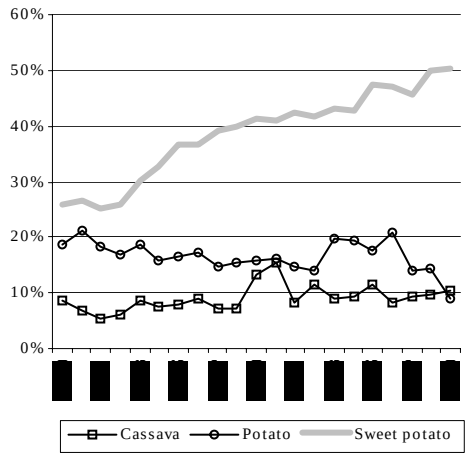


Figure 84. Share of animal feed utilization within the domestic supply of the selected ESCAP countries



The share used as food from domestic supply regularly decreased for sweet potato (from 68 to 44 per cent) and cassava (from 78 to 60 per cent), but increased for potato (particularly since 1997, reaching 67 per cent in 1999). The share used for animal feed from domestic supply increased significantly from 26 per cent to more than 50 per cent for sweet potato. However, this share did not exceed 20 per cent for potato and 10 per cent for cassava. In fact, the share decreased for potato (from more than 18 per cent in 1979 to less than 10 per cent in 1999), and has remained stable for cassava (around 9-10 per cent). Only potato and cassava were consumed as manufactured food. For both crops, the evolution of the share has been irregular, but regarding the period holistically, has increased.

Significant differences can be observed within the region regarding these consumption trends. Only a few countries consume part of their domestic supply as animal feed; eleven countries in the case of sweet potato, six countries in the case of potato (with very low shares except for China and Democratic People's Republic of Korea) and ten countries in the case of cassava. Amongst these countries, shares were very uneven and were mostly increasing or irregular. The share of manufactured food was marginal, except for Japan and Republic of Korea, which manufactured almost all of their cassava domestic supply. Australia has consumed cassava since 1988, on an average of 28 thousand mt per year (1988-1999). Almost all these quantities are used for non-nutritional purposes.

Significant differences can be observed between countries regarding their consumption habits.

Table 41. Evolution of the share of roots and tubers utilized as feed and food, 1979-1999

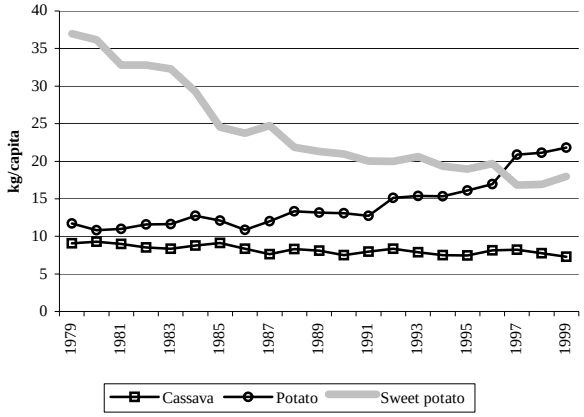
Evolution of the share from 1979 to 1999	Share of domestic supply used for food (total)			Share of domestic supply used for animal feed		
	Sweet potato	Potato	Cassava	Sweet potato	Potato	Cassava
Australia		85%-decreasing			-	
Bangladesh	90%-stable	81%-stable		-	-	
Cambodia	95%-stable		95%-stable	-		-
China	53%-decreasing	60%-decreasing	32%-decreasing	41%-increasing	26%-irregular	46%-stable
Fiji Islands		97%-stable	86%-stable	-	-	10%-stable
India	95%-stable	72%-stable	95%-stable	-	-	-
Indonesia	88%-stable	87%-increasing	79%-small var	2%-stable	1%-decreasing	2%-increasing
Japan	76%-increasing	92%-increasing	100%	9%-decreasing	1.3%-stable	-
Democratic People's Rep. of Korea	78%-stable	70%-irregular		10%-stable	20% - irregular	
Rep. of Korea	50%-decreasing	80%-decreasing	85%	21%-increasing	7%-increasing	13%-irregular
Lao People's Democratic Republic	81%-stable	77%-stable	-	9%-increasing	-	10%-stable
Malaysia		80%-decreasing	64%-decreasing		4%-decreasing	4%-decreasing
Maldives		97%-stable			-	
Myanmar		83%-stable	90%-stable		-	-
Nepal		78%-increasing			-	
New Zealand	90%-stable	75%-decreasing		-	3.2%-increasing	
Pakistan		81%-increasing			-	
Papua New Guinea	85%-stable	92%-decreasing	85%-stable	-	-	-
The Philippines	90%-stable	81%-increasing	89%-stable	5%-stable	-	5%-increasing
Sri Lanka	70%-stable	75%-increasing	69%-stable	25%-stable	-	25%-stable
Thailand	90%-stable	97%-increasing	28%-decreasing	-	-	-
Vanuatu		99% - stable	-		-	-
Viet Nam	85%-stable	85%-stable	84%-stable	10%-stable	-	10%-stable

(i) Figures mentioned are average for the period 1979-1999.
(ii) Remaining percentage could be used as seed, non-food purposes or waste.
(iii) Dark shading = no or very low domestic supply.

Variations in the consumption patterns

On a regional scale, the trends show a slow decrease in the consumption of cassava. The opposite evolution of potato and sweet potato on Figure 85, show that since 1996 potato has progressively substituted sweet potato in Asian and Pacific consumption patterns.

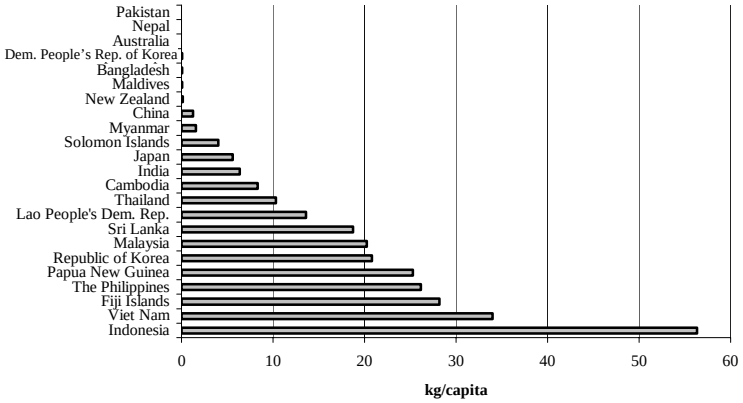
Figure 85. Average consumption (kg/capita) from 1979-1999 of cassava, potato and sweet potato, for the selected ESCAP countries



Cassava

Cassava consumption has decreased from 9 kg/capita/year in 1979 to 7 kg/cap/year in 1999, however, consumption was irregular. The main consumers are respectively Indonesia (56 kg/capita/year) and Viet Nam (34 kg/capita/year), followed by the Fiji Islands (28 kg/capita/year), the Philippines (26 kg/capita/year), Papua New Guinea (25 kg/capita/year) and Republic of Korea (21 kg/capita/year). Some countries like Democratic People's Republic of Korea and Republic of Korea, Nepal and Pakistan consumed almost no cassava. The general decreasing trend in consumption affects particularly Viet Nam (-down 43 kg/capita/year between 1979 and 1999) Sri Lanka and the Philippines (-16 kg). Thailand, China, and Myanmar show a regular trend in the consumption of cassava as food. New Zealand, Bangladesh, Australia and the Maldives, which were not consumers at the beginning of the period, have started to consume small quantities regularly (< 0.2 kg/capita/year).

Figure 86. Yearly average consumption (kg/capita; 1979-1999) of cassava for the selected ESCAP countries

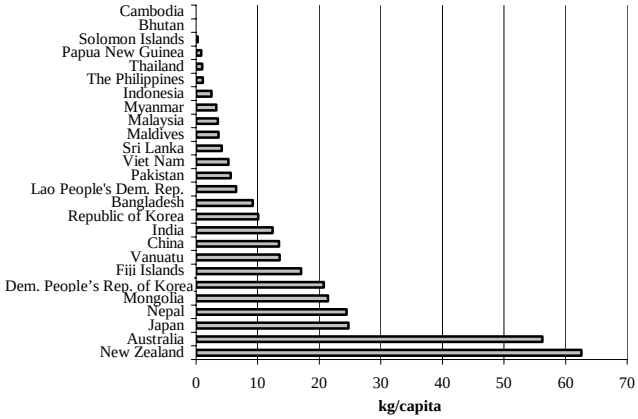


Potato

The consumption of potato increased by 85 per cent in 20 years in the region, reaching 22 kg/capita in 1999.

The main consumers of potato are developed countries, New Zealand (62 kg/capita/year), Australia (56 kg/capita/year) and Japan (25 kg/capita/year). The evolution of the consumption level, per capita per year, is predominantly increasing for all countries, including the main consumers.

Figure 87. Yearly average consumption (kg/capita; 1979-1999) of potato for the selected ESCAP countries

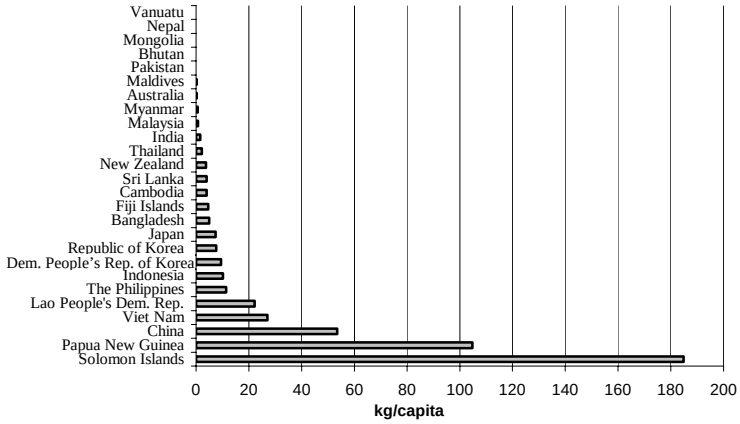


Sweet potato

The consumption of sweet potato decreased by half in 20 years to 18 kg/capita/year in 1999.

The Pacific Islands are the main consumers of sweet potato, with the Salomon Islands and Papua New Guinea consuming respectively 185 kg/capita/year and 105 kg/capita/year, followed by China (50 kg), Viet Nam and Lao People's Democratic Republic. Bhutan, Mongolia, Nepal and Vanuatu consumed almost none. In terms of the evolution of consumption, almost all of the countries experienced a decrease.

Figure 88. Yearly average consumption (kg/capita; 1979-1999) of sweet potato for the selected ESCAP countries



The trends observed in the evolution of domestic supply of root and tuber crops show a progressive substitution of potato for sweet potato, while cassava has remained stable. Food consumption habits and climatic conditions suitable for the cultivation of the different crops are the main reasons given for the situation and of the evolution of the consumption levels of roots and tubers.

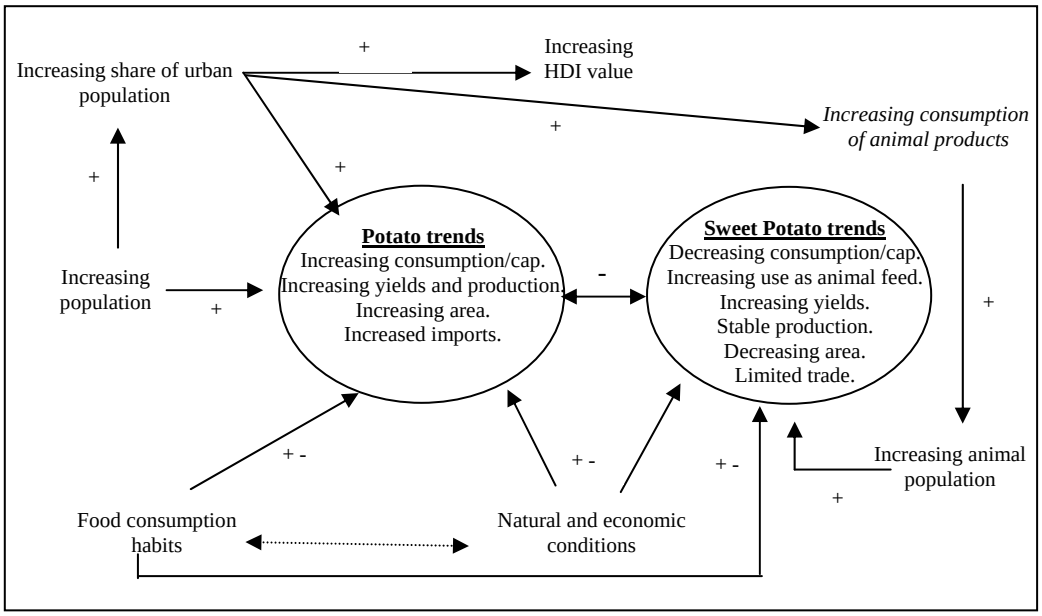
It still can be noticed that:

- ✧ The main consumers of potato include all the developed countries (Australia, New Zealand, Japan).
- ✧ The main consumers of sweet potato include countries with a low HDI value (Pacific Islands, Viet Nam, Lao People's Democratic Republic).
- ✧ No relationship/correlation can be established between HDI value, percentage of urban population, trade aspects and the level of consumption.

Conclusion: Future development of root and tuber crops in the region

Many qualitative or quantitative variables affect differently the future of roots and tubers in Asia and the Pacific, especially potato and sweet potato, as summarised in Figure 89.

Figure 89. Flow chart to shot the influencing to potato and sweet potato trends



Three patterns can be identified:

The first pattern (A) relates to the majority of countries that are still large consumers of sweet potato but small consumers of potato. These countries, characterized by a lower level of development, are increasing their growing area of potato and maintaining or decreasing the area of sweet potato. Consumption of potato is increasing.

Another pattern (B) (Japan, New Zealand and Australia) corresponds to a situation where potato consumption is high and sweet potato consumption is low. For these countries, with a significant level of development (high HDI value) as well as a large urban population, trade (especially imports) is quite significant (at the scale of the country and/or compared to the region's trade) as well as the production of processed food.

China, India, Pakistan, Malaysia and Fiji Islands are in an in-between situation. Given the size of these countries (except Fiji Islands) their evolution will strongly affect the future of potato and sweet potato production and trade in the region.

Table 42. Potato and sweet potato consumption patterns

	Pattern A	Transition	Pattern B
Social and economical situation	HDI low High rural population	Increasing Decreasing	HDI medium to high Rural population < 40%
Pattern of consumption	Low consumption of potato Significant consumption of sweet potato Animal feed uses and processing of food low	Increasing Stable/decreasing Increasing (processed); irregular (animal feed)	High consumption of potato Low consumption sweet potato Processing food increasing
Trend components	Limited trade for potato Negligible trade for sweet potato Increasing production of potato Decreasing/stable production of sweet potato	Increasing Decreasing	High trade High domestic supply of potato Low domestic supply of sweet potato
Countries	Cambodia, Solomon Island, Papua New Guinea, the Philippines, Indonesia, Myanmar, Maldives, Sri Lanka, Viet Nam, Mongolia, Lao People's Democratic Rep.	China, India, Fiji Islands, Malaysia, Pakistan	New Zealand, Australia, Japan, Democratic People's Rep. of Korea

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Appendix

Appendix 1. List of CGPRT Crops (FAO classification)

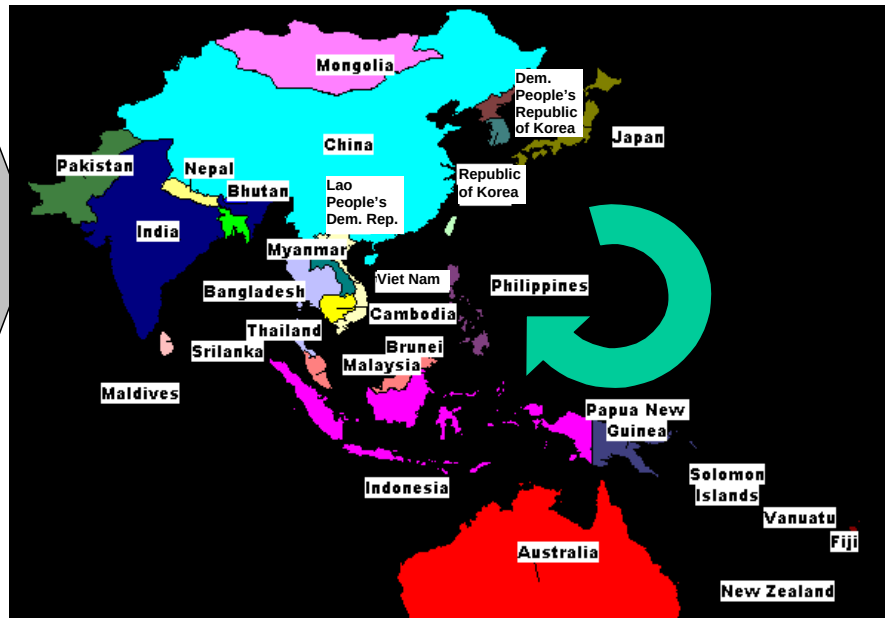
Coarse grains
Barley
Maize (Zea mays) *
Pop corn
Rye
Oats
Millets (Setaria and Panicum)
Sorghum (Sorghum bicolour)
Buckwheat
Quinoa
Fonio
Triticale
Canary seed Mixed grain
Cereals nes
Pulses without soybean and groundnut
Common bean (Phaseolus spp.)
Broad bean (Vicia faba)
Peas (Pisum sativum)
Chickpea (Cicer arietinum)
Cowpea (Vigna unguiculata)
Pigeonpea (Cajanus cajan)
Lentil (Lens culinaris)
Bambara beans
Vetches
Lupines
Pulses nes
Groundnut (Arachis hypogaea) *
Soybean (Glycine max) *
Roots and tubers
Potato (Solanum tuberosum) *
Sweet potato (Ipomoea batatas) *
Cassava (Manihot esculenta) *
Yautua (Cocoyam)
Taro (Colocasia esculenta)
Yams (Dioscorea spp.)
Roots and tubers nes

Appendix 2. Trade of maize in the ESCAP region (average 1979-1999)

25 million MT

IMPORT from outside the region

(USA, Argentina)



TRADE inside the region: 3.5 million mt

EXPORT to outside the region: 2.3 million mt

MAIN ACTORS

China : 70% of region's exports for the period

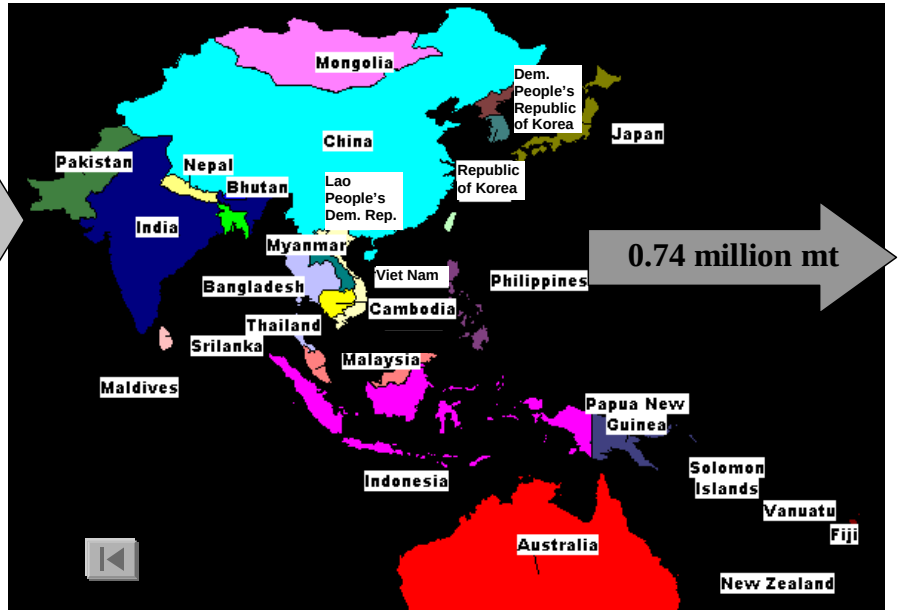
Japan : 54% of region's imports for the period

Appendix 3. Trade of soybean in the ESCAP region (average 1979-1999)

9.5 million mt

IMPORT of the region

(USA, Argentina)



0.74 million mt

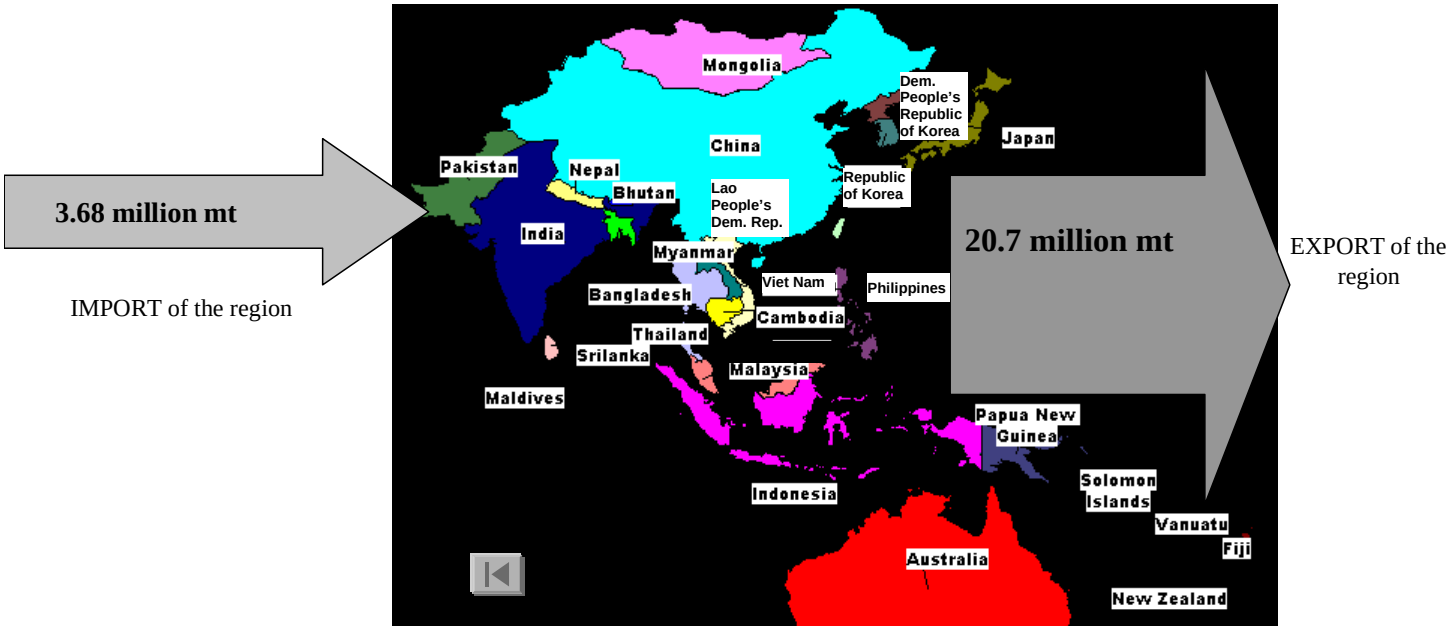
EXPORT of the region

MAIN ACTORS

China : 90% of region's exports for the period

Japan : 49% of region's imports for the period

Appendix 4. Trade of cassava in the ESCAP region (average 1979-1999)



MAIN ACTORS

Thailand : 84% of region's exports for the period

China and Republic of Korea : 39% and 28% of region's imports for the period

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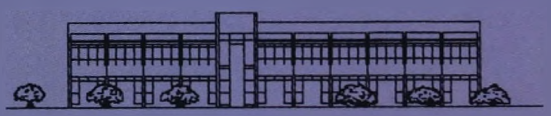

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