Textbook HS No. 2

Country Report

on

Hydroponics and Soilless Culture

June, 1991

Tsukuba International Agricultural Training Center

Japan International Cooperation Agency

FOREWORD

This year four persons from three countries participated in the Hydroponics and Soilless Culture Course conducted at the Agriculture and Forestry Research Center of Tsukuba University.

The purpose of this course is to bring up practical knowledtge in soilless culture for those who have a broad viewpoint and scientific knowledge both in theory and technology through lectures, experiments, and practice on various vegetables and flowers.

This is a compilation of the country reports presented at the seminar on the present condition and state of soilless culture and horticultural production in the respective countries by the participants in the Hydroponics and Soilless Culture Course for the year, 1991.

The main objective of the country reports is to exchange their information about problems in soilless culture horticultural production.

We hope that this report will contribute to the development of soilless culture. Lastly, I would like to express my sincere gratitude to all persons who have concerned with this course in the University of Tsukuba.

June, 1991

Tsuyoshi Eida
Director
Tsukuba International Agricultural
Training Centre
Japan International Cooperation Agency

CONTENTS

Agriculture Development in Bali, Indonesia

Dewa Nyoman Ngurah Raka Djaja
(Indonesia)

I. Natural Condition

Bali is one between 27 Provincial in Indonesia and has smallest area among them. Even though, Bali is very popular because Bali is one of famous tourist destinations in Indonesia.

Balinese topography are varied, from coast area up to the mountainous area. The vegetation are also varied, which enable Bali to produce many kinds of agricultural product, such as animal husbandry, fishery, food crops, and estate crops products.

Total land area of Bali is about 563,286 ha, in which land utilization are as follows

1.	Paddy field	93,291.51 ha
2.	Yard and surrounded	32,639.53 ha
3.	Field	154,749.29 ha
4.	Swamp	193.00 ha
5.	Sea fish pond	502.00 ha
6.	Fish pond	1,748.00 ha
7.	Temporary unutilized land	4,361.51 ha
8.	Wooden land	13,324.00 ha
9.	State forest	122,830.00 ha
10.	Estate crops	99,992.51 ha
11.	Others	36,600.00 ha

From these data, it can be seen that land utilization in Bali is almost maximum and 20% of forest area is still left which may be not so good for ecology system in Bali island.

Province of Bali consists of one main island and about five small islands divided into eight districts and 51 sub districts.

Bali has two kinds of season,

- Dry season: April to October
- Wet or Rainy season: October to April

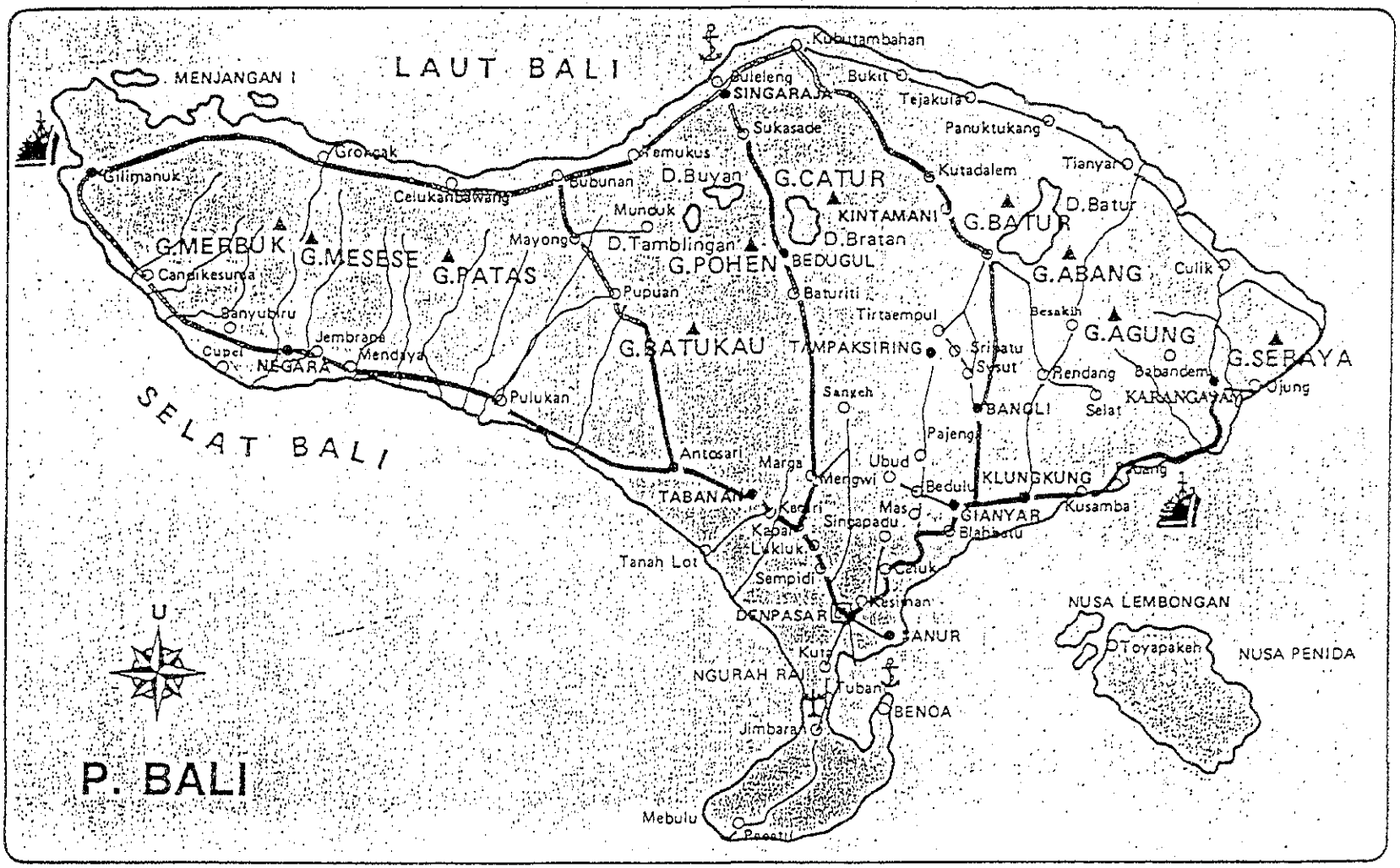
Meanwhile these seasons are really unpredictable, which means that dry season could last very long.

According to the climate condition data in Bali, the driest month is on July with the number of rainfall about 7.6 mm and the wettest is on January with the number of rainfall about 407.1 mm. There are about 10 mountains in Bali, and the biggest is Agung Mountain, which last erupted in 1963, and caused a lot of victims.

Table 1. Average climate condition in Bali

Month	Number of rainfall (mm)	Average minimum of temp. (°C)	Average maximum of temp. (°C)	Average relative humidity (%)	Average percentage sun shine (%)	Average wind velocity (knot)	Atomos-phere (milibar)
January	407.1	23.9	30.4	84.0	47.0	6.0	1,008.0
February	256.5	23.4	30.7	81.0	65.5	4.6	1,009.8
March	62.2	24.3	31.1	84.0	75.0	3.0	1,009.4
April	137.6	24.2	31.4	83.0	86.0	3.8	1,010.3
May	35.0	23.0	30.6	81.0	95.0	5.0	1,011.7
June	72.7	23.8	29.8	85.0	63.3	4.0	1,010.0
July	7.6	22.4	29.5	80.0	82.8	5.4	1,012.6
August	72.5	22.2	29.1	76.0	81.8	6.0	1,012.8
September	52.6	23.0	29.9	80.2	95.3	6.,0	1,013.7
October	9.5	23.9	30.7	78.2	68.5	5.0	1,013.8
November	231.5	24.6	31.0	79.8	77.8	4.0	1,011.6
December	159.6	24.1	31.8	81.7	80.3	2.3	1,011.7

Source: Meteorogical Station and Geophisics Region III, Denpasar, Bali


LAUT BALI
MENJANGAN I
Kubutambahan
Buleleng
SINGARAJA
Bukit
Tejakula
Panuktukang
Sukasada
Gerokgak
Temukus
Gilimanuk
Celukanbawang
Bubunan
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G.CATUR
Kutadalem
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KINTAMANI
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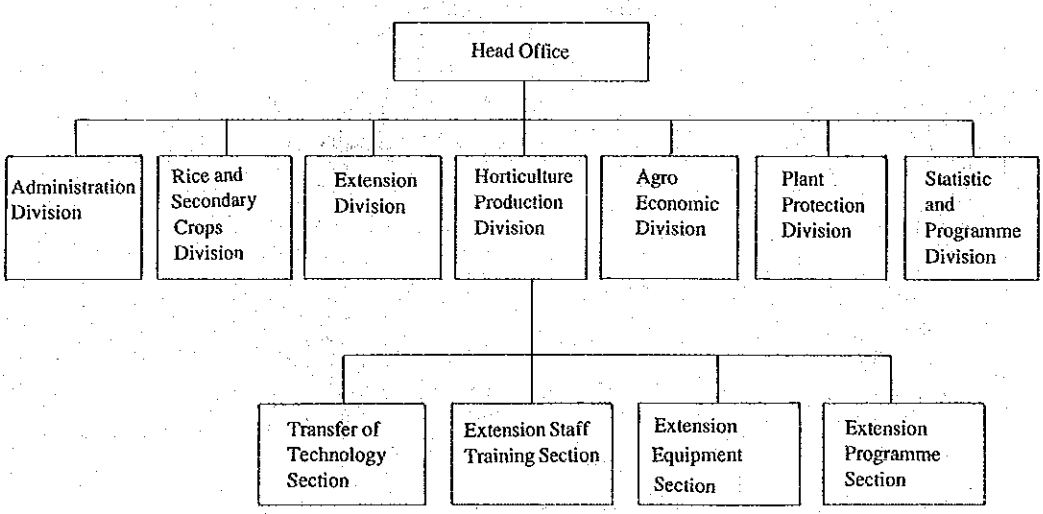
Pajenga
Antosari
Marga
Ubud
Mengwi
Beduluh
KLUNGKUNG
TABANAN
Kerobokan
Mas
GIANYAR
Kusamba
Kapal
Sinapadu
Blahbatuh
Lakluk
Tanah Lot
Celuk
Sempidi
Kesiman
NUSA LEMBONGAN
DENPASAR
SANUR
Toyapakeh
NUSA PENIDA
Kuta
NGURAH RAI
Tuban
BENOA
Jimbaran
U
P. BALI
Mebulu

II. Agriculture in General

Bali is divided into 8 (eight) districts and each district has its own administration system. The head of provincial government is the governor and at the district level to be led by Bupati (Indonesian term). Administration system in agriculture follow these systems, which means that in provincial level there are provincial agriculture extension service and in district level there are district agriculture extension service. Each level has the same structure as below:



The main duties of agriculture extension service province of Bali are:

- Extension services to farmers in Bali.
- Assist farmers in Bali in obtaining their agriculture inputs.
- Make decision on agriculture policy in Bali.

The duty of transfer technology section is:

- Provide the agricultural extension activities such as: Audio visual activities (radio and TV program), reading materials, demonstration to the farmers in Bali.

- Discussion with farmers concerning their efforts and problems to achieve their higher production and income.

The Training and Visit (T.V.) system is applied in Bali as one of the extension activities. By this system the farmers continuously are visited by agriculture field extension workers and the agriculture field extension workers regularly and every week will get the training form agriculture extension service province or district agriculture extension service.

There are about 593 of agriculture field extension workers in Bali and all of them have base camps in 29 rural extension center.

In rural extension center, all extension activities are done such as: farmer's discussion, training, extension materials preparation, etc. Farmers, if they need more information can come to rural extension center, but extension policy in Bali focuses on group approach. Each rural extension center has at least 1 hectare garden which is used for demonstration. The number of agriculture field extension worker in every rural extension center depends on the area of those rural extension centers.

According to Training and Visit system in extension, the agriculture field extension worker's area is divided into 16 farmer's group area. By this division, workers visited 8 farmer's group area every week and return 2 weeks later. Visiting farmer's group area is done 4 days a week and other 2 days is used for training and reporting purpose.

Many kinds of extension method are used by field agriculture extension workers such as: demonstration, farmers group meeting, slide show, etc. The important thing which has to be done by agriculture field extension workers to applied Training and Visit system is they must have farmers' groups.

Luckily in Bali, field agriculture extension workers do not have to reform a new farmers group because there are traditional farmers' groups which were reformed at least 900 years ago and the name is SUBAK. Agriculture in Bali has been developed by the SUBAK farmers organization and agriculture field extension workers hand in hand..

III. Horticultural Crops Production

The major horticulture crops cultivated by Balinese farmers are vegetables and fruits. The cultivation of the ornamental plants started a few years ago and mostly those kinds of plant are supplied from other island i.e. Java. But since there are a lot of hotels which need for the ornament plants at their garden, farmers started to grow those plants.

Topography of Bali island is so variable which can offer an excellent environment for the production of any kind of vegetables. Bali can produce such upland vegetables as i.e.: carrot, cabbage, white carrots, garlic tomato, etc., and also the lowland vegetables i.e.: onion, cucumber, red bean, egg plant, spinach, chili, string bean, etc.

Because of increase of vegetable consumption at local and of hotels requirements, the vegetables production also has increased year by year. Planting area, harvesting area, productivity and total production of vegetables in Bali in 1990 are as follows:

Type of vegetables	Planting area (ha)	Harvesting area (ha)	Productivity (ton/ha)	Total production on 1990 (ton)
Onion	2,082	1,783	7.03	12,535
Garlic	2,175	1,576	8.30	13,086
Onion leaves	179	205	8.45	1,734
Potato	313	291	9.46	2,753
Cabbage	1,018	1,050	37.45	39,301
Petsai	744	662	21.72	14,381
Carrot	202	232	15.40	3,575
White carrot	30	38	28.05	1,066
Red beans	12,938	12,419	1.04	12,965
String beans	1,295	1,075	5.97	6,423
Chili	3,921	3,153	6.50	20,519
Tomato	442	383	9.74	3,734
Egg plant	76	39	19.87	775
Green beans	1,211	1,215	4.84	5,888
Cucumber	1,177	1,106	7.73	8,553
Gourd	77	44	45.59	2,006
Spinach	181	195	27.73	5,409
Kangkung	89	92	27.73	5,409

Compared to vegetables productivity in 1986, productivity in 1990 is almost stable and in case of some vegetables even lower. One reason for these low yield levels could be related to the very distinct dry and wet season in Bali. In the wet season, yield levels of some vegetables sometimes is very low due to severe diseases problem. These problems are aggravated due to the non availability of resistent varieties.

Mostly vegetables production in Bali is only enough to supply for the local market and hotels requirements which means that Bali can not export to other islands in Indonesia. Sometimes if vegetables farmers can not provide a good quality of vegitables for hotels, then hotels will buy from outside of Bali.

This means that Bali sometimes also imports some kind of vegetables from Java, but the importation datas are not available.

As mentioned before, farmers in Bali can produce upland vegetables and low land vegetables. This means that growing fields of these two kinds of vegetable are different. Upland vegetables such as cabbage, carrot, tomato, parsley grow at mountainous area and lowland vegetables grow at rice field area. This condition causes the difference in the planting time between upland and low land vegetables.

Upland vegetables grow during rainy season and lowland vegetables during dry season as secondary crops at rice fields. This means that almost all vegetable crops are cultivated all the year round throughout Bali and only a few are done in different way.

Cultivation methods applied by Balinese vegetable farmers are traditional ways and only a few of them try to apply a new technology. Most of them are using local varieties for their plantation. For these conditions, since 2-3 years ago, agriculture extension services have been doing some demonstration farm introduce new varieties of some vegetables and introduce new cultivation methods to the farmers. The irrigation for vegetable cultivation at upland area is done by using a rain fall, and at lowland area the irrigation system owned by traditional farmers organization or SUBAK.

For the fertilizer application, most of the farmers are using organic manure i.e.: green manure or animal waste. But, for the rice field area, farmers mostly use chemical fertilizer i.e.: Urea, T.S.P. and KCl.

Pest and diseases control is also done by the farmers but since agriculture extension service introduced the integrated pest management control, farmers spray their plantation when the population of the pest exceeds economic injury levels.

Marketing system of vegetables production in Bali are still complicated. There are still too many channels from farmers as producer to the market. Vegetables produced by farmers are bought by collectors, and collectors sell to middlemen. Middlemen then bring to the market and then sell to retailers. Finally consumers buy from retailers with rather expensive price compared to farmers' price. This condition has made farmers get very small income from their farming but, on the other side, the vegetable price in the market is still rather expensive. There are many problems in vegetable crops production in Bali but the major ones are:

- Marketing system, which means that as long as marketing system does not change to better one, vegetable farming would not be developed.

- The farmers are still very poor in knowledge of vegetables, which means that agriculture extension services have to try harder.

IV. Hydroponics and Soilless Culture in Bali

Actually there are no hydroponics and soilless culture which are practiced in Bali. All horticulture farmers in Bali apply soil farming method. Balinese farmers are still very poor in knowledge and knowhow. It's because most of them are primary school graduates. So, they do not have an ability to practice such modern technology as hydroponics and soilless culture. This situation made agriculture extension service have a big problem in introducing the new technology to achieve high production. The food requirement has increased year by year, which is due to increasing of population and visitors to Bali.

Year	Number of population	Number of visitors
1986	2,600,396	283,074
1990	2,701,283	524,135

Other serious problems for agriculture development in Bali are:

- Land utilization for agriculture purpose has become less and less
- Water used for agriculture irrigation purpose has become further less because of hotel water requirement.

Every year, almost 1,000 ha of fertile soil land have changed its function.

1986:	97,336.92 ha
1987:	95,730.11 ha
1988:	95,061.12 ha
1989:	94,102.00 ha
1990:	93,291.51 ha

All of the above figures will bring a big problem for Balinese Government next 5-10 years later. This means that the demand for the future food or agriculture product will increase year by year, while the land for production will become less and less.

The efforts which already have been done by Balinese agriculture extension service are:

- Diversification on agriculture farming and food menu.
- Intensification on all agriculture commodity

- Rehabilitation through sleeping land utilization

- Extensification, which means that Balinese Government tries to open a new area to be a rice field

Sleeping land problems are really serious in Bali. This problem probably can be solved by introducing the hydroponics and soilless culture. It is just because these kinds of the land have not irrigation system.

It will take time to bring up hydroponics and soilless culture to farmers level. Farmers should get the information and training before they try to practice these systems. Hopefully 2-3 years later, farmers in Bali will be able to start.

Country Report

M.M. Golshan Ardakani
(Iran)

The following report contains two sections:

A. Geographical and climatical conditions of Iran in general.

B. Geographical and climatical condition of Yazd province.

A. Iran has a total area of about 1,650,000 square kilometers. It lies between 25 and 40 degrees north latitude and 44 64 degrees east longitude.

Iranian territory is composed to a large extent of mountains surrounding the saline, sandy,and rocky deserts of the central plateau and forming a closed basin containing many kinds of accumulations.

There are four main physiographic areas in Iran, each with a distinctive character:

1. The Zagros and Elburz range of mountains in the form of great V.

2. The area within the V, which begins as a high plateau with its own secondary ranges and gradually descends into deserts.

3. The region of Khuzistan, a low-lying and a continuation of the Mesopotamian plain.

4. The Caspian Sea coast which is below sea level and forms a separate climatic zone.

Over 50 percent of the total land surface of Iran is mountainous and rough, and includes areas mapped as soils of dissected slopes and mountains.

Climate

Although Iran is predominantly an arid and semiarid country, there are considerable variations in climate from one part of the country to another. These variations, influenced by orography and physiography, are reflected in the climatic provinces of Iran. These provinces are based on Koeppen's system as adapted by Dr. Canji in his publication, "The Climates of Iran."

Rainfall

A map of average annual precipitation in Iran was issued in 1959. This was composed of 9 subdivisions, 5 of 0 to 500 mm in steps of 100 mm, and 4 of 500 to over 2,000 mm in steps of 500 mm (500 - 1,000 - 1,500 mm, 1,500 - 2,000 mm, and over 2,000 mm). For the purposes of this study these have been simplified to the following five soil moisture regions with some description given below:

Average annual precipitations

"Arid"	less than 100 mm
"Semiarid"	100 - 250 mm
"Dry subhumid"	250 - 500 mm
"Moist subhumid"	500 - 1,000 mm
"Humid"	1,000 - 2,000 mm

"Arid region": Influenced by geographic position as well as by elevation. The two areas in Iran which are in this region form part of the Kavir region including Dasht-i Kavie, Dsht-i-Lut, both in the 500 - 1,000 m elevation zone; they occupy 221,000 sq km or about 13 percent of the total surface of Iran.

"Semiarid regions": Normally between 100 and 250 mm average annual precipitation; includes a good portion of the coastal area of the Persian Gulf and Gulf of Oman as well as Khurasan and Azerbaijan and central Iran. Most of this region is in the 1,000 - 2,000 m elevation zone and occupies 1,005,000 sq km or about 61 percent of the land surface of Iran.

"Dry subhumid regions": Normally with 250 - 500 mm average annual precipitation: this region includes large mountainous areas of the Elburz and Zagros systems, mostly over 2,000 m or at least over 1,500 m. It occupies 280,000 sq km or about 17 percent of the land surface of Iran.

"Moist subhumid regions": Consist of the higher peaks of the Zagros and Alburz ranges and part of the eastern coastal area of the Caspian Sea in the north; average annual precipitation is between 500 and 1,000 mm. It occupies 134,000 sq km or about 8 percent of the land surface of Iran.

"Humid regions": Consist of the southern Caspian coastal area (normally below main sea level), Anazali, Ramsar, and other areas, having average annual rainfall of 1,000 - 2,000 mm. It occupies 14,000 sq km or about 1 percent of the land surface of Iran.

B. Yazd province comprises an area of approximately 60,000 sq km, located at the central plateau of Iran with altitude of 1,222 m above sea's surface with regard to Iran's central plateau environment. Yazd natural characteristics are very harsh. The province is bordered by fars, Ispahan, Khorasan and Kerman provinces. It,

mountains are parts of central mountainous region of Iran with the height of 4,000 m in the southwest, known as shier kooh (Lion mountain). The low lands of province are in the north and northeast of Kawir siah kooh (mountain black desert altitude of 980 m above sea's surface.)

The plant covering of province are mostly Artemisa Herba Alba Salsola Spp - Fortyuinia. Sp - Seidlitzia Rosmarinus - Tamarix. Sp. However the high plateau, located in the mountainous areas and high lands, are rather rich with regard to plant covering and other natural factors.

Climatic Conditions

Yazd climate is harsh dry and desert-like. Annual rainfall is low and the degree of evaporation is very high due to rather low humidity and hot weather with great fluctuation. Thereby the province has the vast peculiarities of the world's deserts. The annual temperature ranges from plus 45.5 °C to minus 16 °C. The coldest months are January and February and the hottest are June and July.

The average annual rainfall varies from 60 to 80 mm and the variation is indeed very high. In the last decade, the annual rain fall has been between 23 mm and about 123 mm. Precipitation is mostly in the winter and spring and in some years, the half annual snow and rain falls in only 24 ours. As mentioned earlier the annual evaporation is very high and sometimes reaches to 4,000 mm in a single year.

Agriculture

Yazd province has a vast area of land yet due to harsh desert-like and particularly the acute shortage of water, only about 1% of its land is cultivated. This has hindered the growth of agricultural factors and makes its further development almost impossible, agricultural activities are done through intensive cultivation of land in the small plots. The average house hold cultivating land is not more than one ha. Farming products of province are mostly hay and cereals, and the orchardic products are pistachio and pomegranat. The area of pistachio orchards of Yazd is about 5,000 ha that produces 2,500 tones of pistachio annually and the area of pomegranate orchards is about 7,500 ha with the production of 75,000 tones of pomegranate a year.

Pistachio is mainly exported to Europe and the U.S.A. and pomegranate to Europe and south Persian Gulf countries.

In recent years, cultivation through controlled environment known as plastic cultivation has been introduced. However, the hydroponics cultivation is not used except for research works.

General Information on Agricultural and Natural Resource Research Organization

A.N.R.R.O., one of the two major divisions of Agricultural Ministry, has the responsibility of studying, surveying and, finally, reporting the characteristics of agricultural and natural resources. The scope of its duty is to define the problems of agricultural production and study the ways to overcome and improve these problems.

Soil and Water Research Institute of A.N.R.R.O., is responsible for survey to classify the soils of the country and the problems of their management and limitations for, irrigation and drainage, plant nutrition purposes. Any research work, dealing with soil and water problems in agriculture should be prepared by an expert, containing the subjects special topic, purpose of the study, materials and methods, costs of conducting and literatures cited. Then, it is submitted to A.N.R.R.O for final technical and financial approval. I have been involved in Yazd Agricultural Res. Center in subdivision of Soil & Water Res. Institute since 1980 up to present.

Horticultural Crop Production

The major horticultural crops in Yazd are obtained from irrigated soils which include Melon, Water melon, Tomato, Cucumber, Leafy vegetables, and Potato. So a variety of fruit trees are cultivated in Yazd which are mostly Pomegranate, Pistachio Almond and others, such as Grape, Apricot, Peach found in some area. The Pomegranate which is cultivated in Yazd is the most famous one in Iran. As mentioned earlier, Pomegranate and Pistachio production are mainly exported to other provinces and foreign countries.

Cropping System of major horticultural crops

In Yazd, agricultural activities, particularly horticultural crops production are done through intensive cultivation. Small plots, heavy soils, and insignificant organic matter cause that most farming affairs especially in refer to vegetable crops production done by hand.

Marketing System

Marketing system in Yazd includes whole markets which receive all kinds of vegetable and fruit. The work system of these markets is as follows:

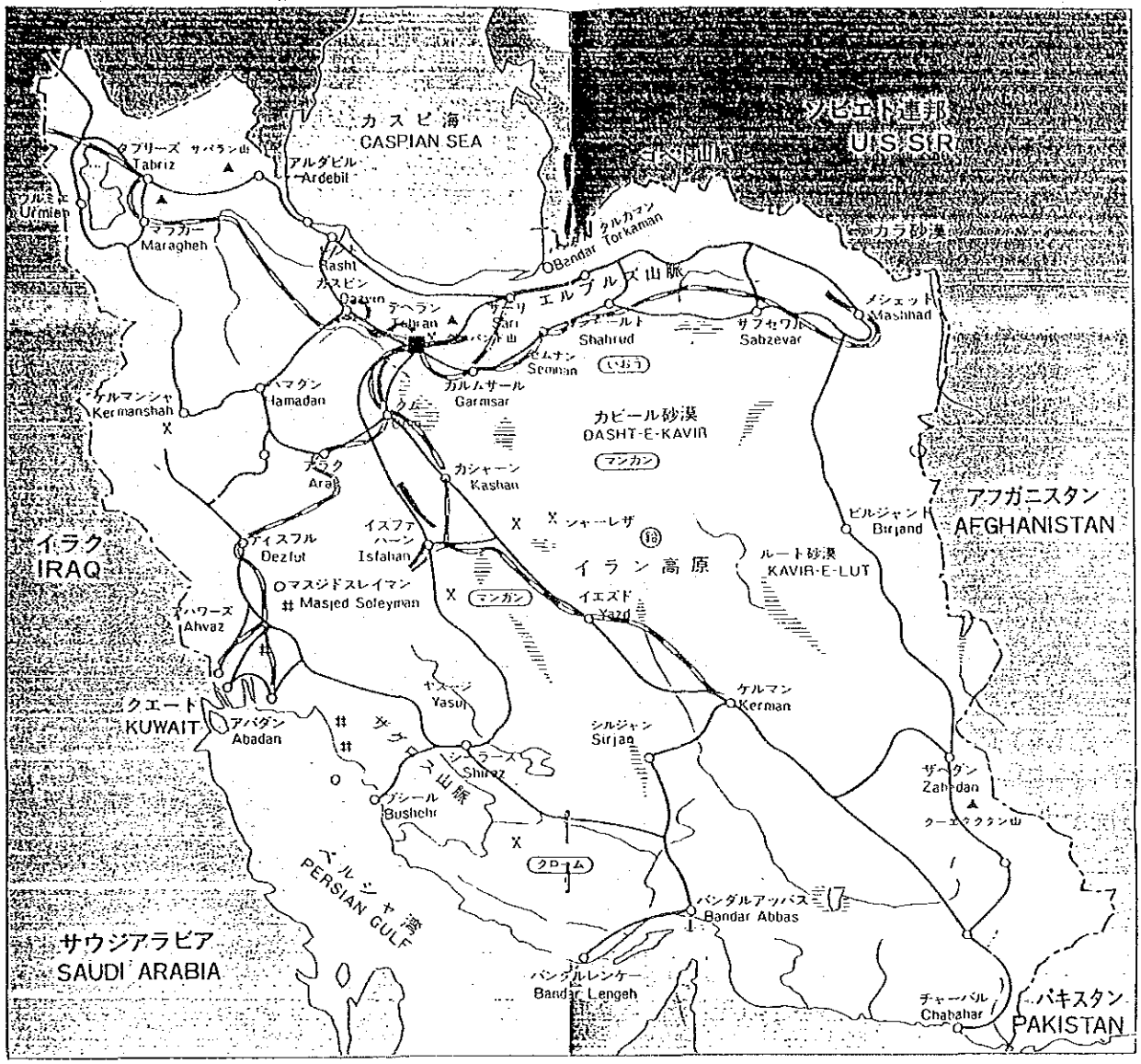
Farmers bring their products early in the morning and sell to the shops' owners which offer them to the small shops in fixed prices which are determined by the special committee. Sometimes farmers sell their products directly to consumers if it would be small quantity.

Major problems in horticultural crops production as follows:

1. Salinity of soil. Most of the soils in Yazd area saline
2. Shortage of supply of irrigation water

3. Absence of price policy.

4. Export system is not clear.



Vegetable Crops and Hydroponics and Soilless Culture

Wu Zhonghua
(People's Republic of China)

1. Natural Condition

(1) General information

The people's republic of China is located in the southeast of Eurasian continent, at the middle latitude region, lies between longs. 73°E and 135°E lats. 4 N and 53°N, with a population of 1,200 million and an area of 9.6 million square kilometers. Its latitudinal position corresponds closely to that of the United States, and the both countries have the same east-west spread. From east to west, China's territory measures more than 5,000 kilometers, and from north to south it extends more than 5,500 kilometers. China borders on twelve nations: North Korea on the east; the Soviet Union on the northeast and northwest; Outer Mongolia on the north; Afghanistan, Pakistan, India, Nepal, Sikkim, and Bhutan on part of the west and the southwest; and Burma, Laos, and Vietnam on the south. The coastline stretches 18,000 kilometers, and the land frontier extends for 14,966 kilometers.

(2) Topography

P.R. China's topography varies widely. In general, it is like a three-step staircase, descending from west to east. The highest section is located in south west, where the Qinghai-Xizang Plateau rises for the most part to more than 4,000 meters above sea level, thus constituting the highest land mass in the world. The second section slopes north and east of the Qinghai-Xizang Plateau and basins at the altitudes of 1,000 - 2,000 meters. The lowest section, mostly below 500 meters, is made up of the Northeast Plain, the North China plain, the middle and lower Chang Jiang plain, and the South eastern Hills. Most of China's rivers follow this sloping contour from west to east to empty into the sea. According to investigation, China is consisted of 12% plains, 19% basins, 10% hilly land, 33% mountainous areas and 26% plateaus.

(3) Climate and vegetation

With vast territory and wide range of altitudes, China has a diversified climate: tropical zone, subtropical zone, warm temperate. And with an annual average precipitation of 630 mm, but there are great difference from north to south, from west to east. In the Center of China, the annual rainfall about 1,000 millimeters, in the northeastern region has an annual precipitation range from 400 to 1,000 millimeters, in many places along the southeastern coast, the annual rainfall exceeds 2,000 millimeters, but in the Northwest China has the least rainfall, and in the desert there is no rain the year round. Not only is China's rain fall distributed unevenly throughout the country but also it varies widely from season to season. More than 80% of the rainfall in China occurs between May and October during the summer monsoon season.

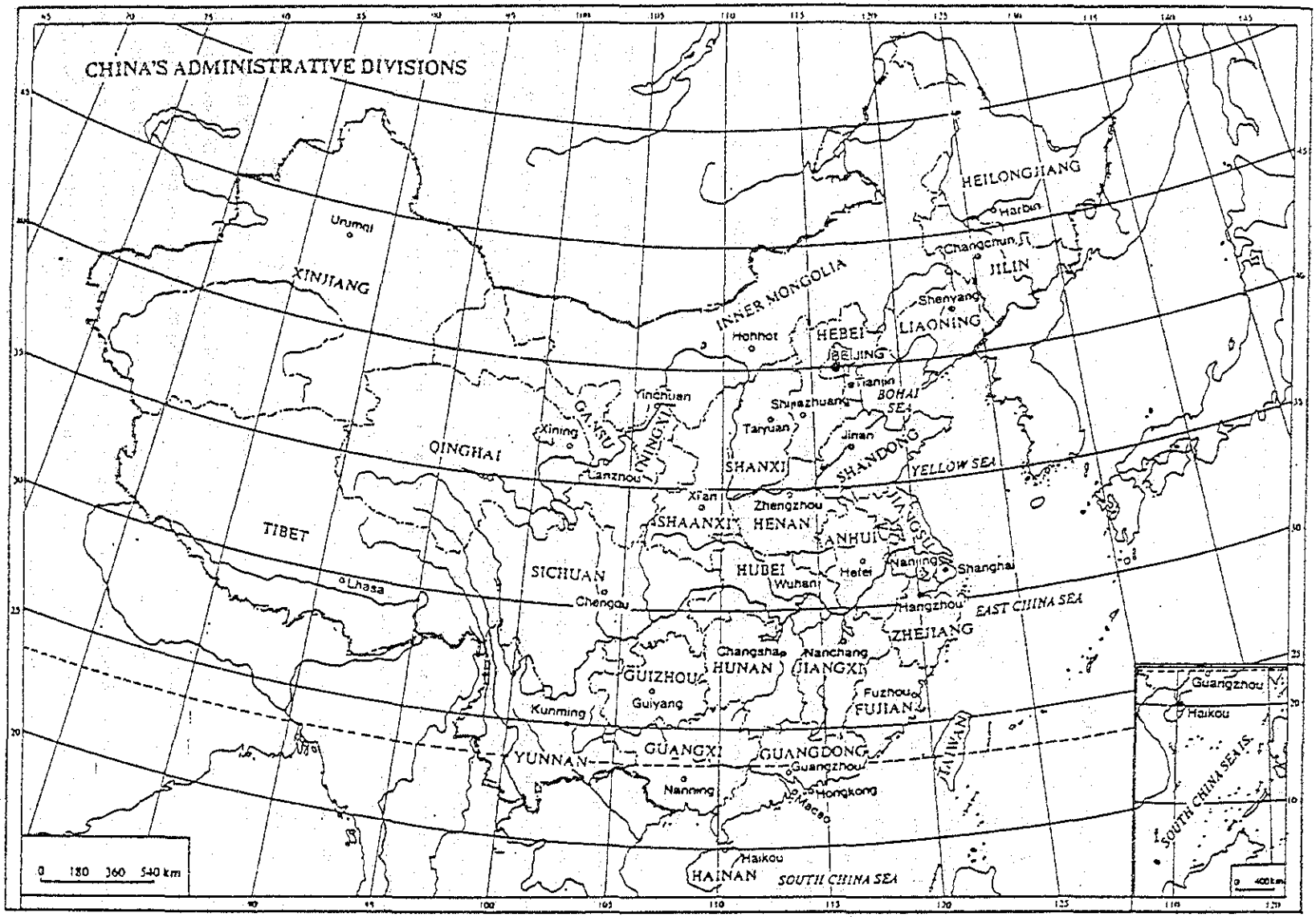


Fig. 1 China's administrative division

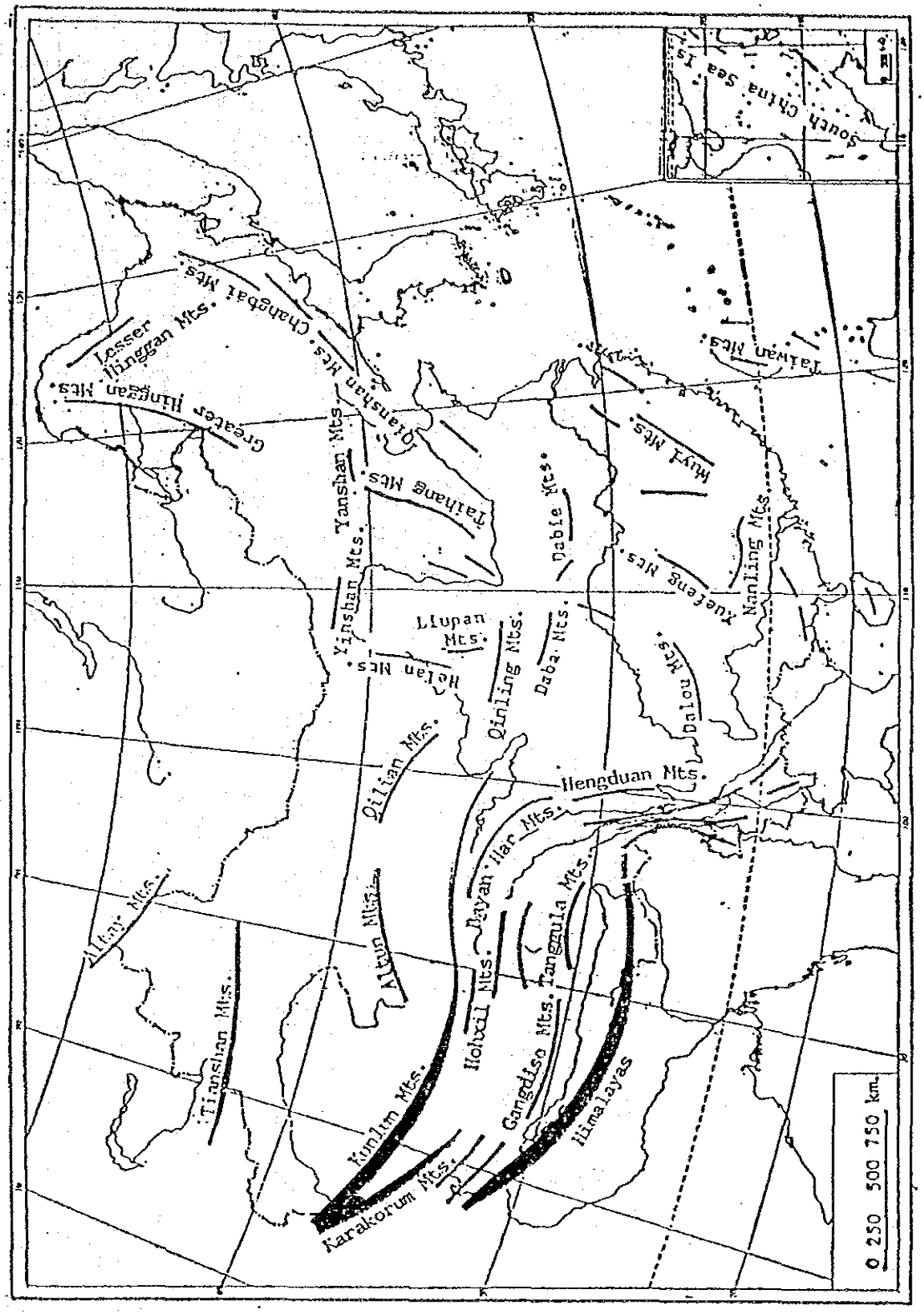


Fig. 2 China's mountains

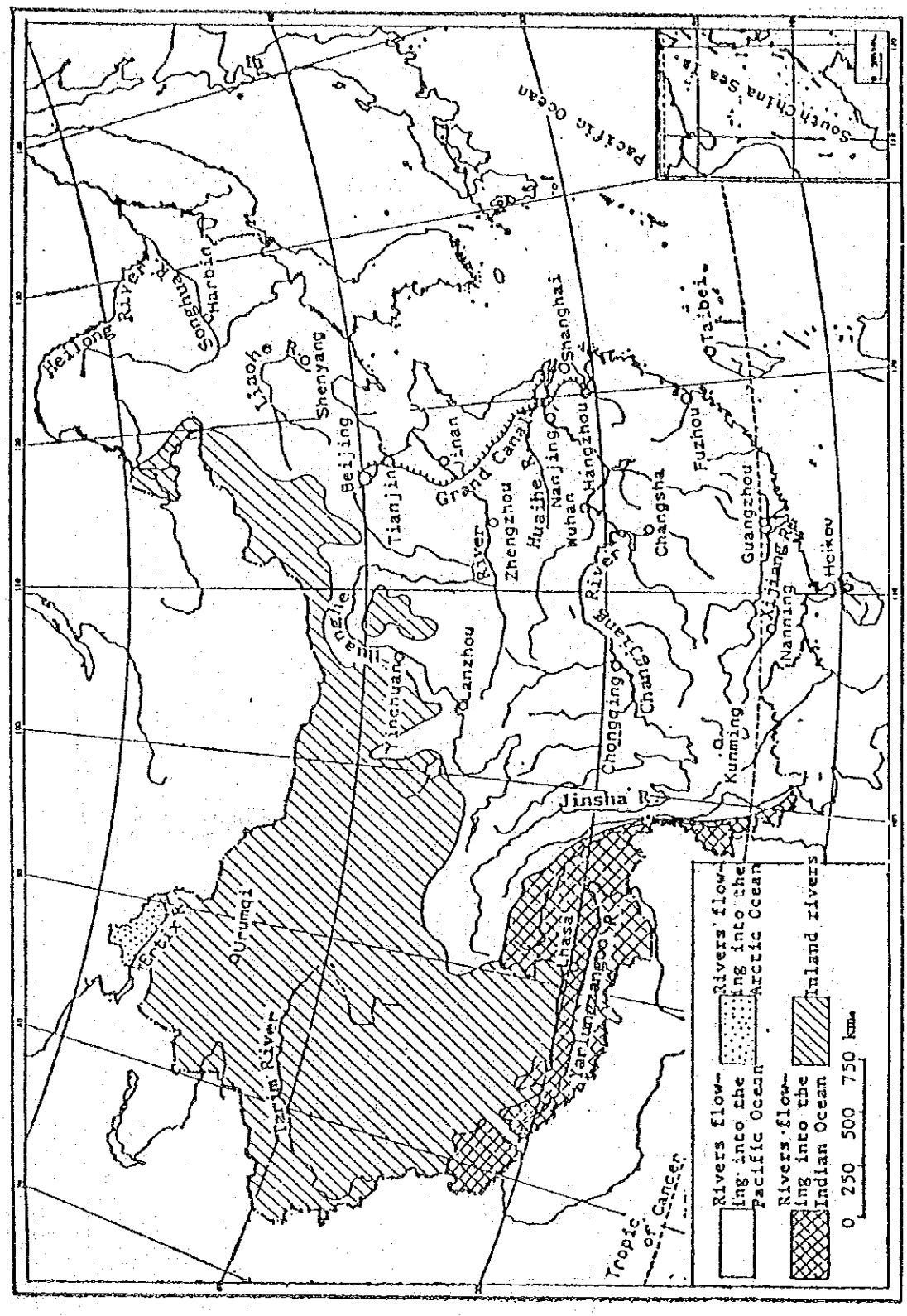


Fig. 3 China's rivers

The wide range of temperature and humidity from one place of the country to another results in a great variety of plant life. There are about more than 30,000 varieties of seed-bearing plants in China, of those varieties, more than 5,000 area woody, and nearly 1,000 are timber trees of excellent quality and high value. Most of the crops grown in other parts of the world can be grown in China. Among the food crops, both paddy rice and wheat are produced in great quantities. There are also more than twenty lesser staples, including maize, kaoliang, and sweet potatoes. Cash crops are grown in great variety and quantity and include the raw materials used in textile, oil pressing, sugar-refining, tobacco, and other industries.

2. Agriculture in General

(1) General information about agriculture

China is an old agricultural country, and has rich agricultural resources. At present, there are more than 100 million ha of arable land, 115 million ha of forests, and 78 million ha of waste land and waste hills which is suitable for afforestation. In addition, there are 319 million ha of grasslands with 224 million ha of usable land, and there are 16.6 million ha of freshwater areas with 5.1 million ha of these suitable for agriculture.

(2) Agro-climate zones

According to the condition of nature, the facts of the agriculture production and the factors of economic and society, the agriculture area are divided into eight agro-climate zones:

(1) The south of China agro-climate zone

(2) The middle and lower Chang Jiang plain agro-climate zone.

(3) The north of China agro-climate zone

(4) The northwest agro-climate zone

(5) The southwest agro-climate zone

(6) The northwest yellow soil plateau agro-climate

(7) The Qinghai-xizang plateauagro-climate zone

(8) The Monggol-xingjiang agro-climate zone

Table 1. The characteristics of china's climate: hot ana rainy in summer, cold and dry in winter; humid in the east, dry in the northwest; the temperature decrease from south to north, the humidity increases from north to south

	Annual sunshine hours (hours/ year)	Maximu average monthly tempera- ture (°C)	Minimum average monthly tempera- ture («C)	Yearly extreme minimum tempera- ture (°C)	Yearly extreme maximum tempera- ture (°C)	Frost- free period (days)	Annnual precipi- tation (mm)	Precipi- tation from April to Septem- ber (mm)
Harbin	2,656.9	22.7	–19.0	–38.1	35.4	136	553.5	493.0
Shenynng	2,568.2	24.6	–12.1	–30.5	35.7	150	755.4	662.0
Beijing	2,778.7	25.9	–4.7	–27.4	40.6	179	682.9	632.9
Zhengzhou	2,387.1	27.4	–0.3	–15.8	43.0	214	635.9	515.0
Wuhan	2,047.9	29.0	3.0	–17.3	38.7	253	1,260.1	916.6
Gunnzhou	1,909.0	28.3	13.1	0.1	37.6	353	1,680.5	1,374.0
Yaxian	2,473.1	28.2	20.8	5.7	35.3	365	1,257.3	883.7
Shanghai	2,015.9	27.9	3.3	–9.1	38.2	236	1,128.5	801.3
Chengdu	1,237.5	25.5	5.4	–4.3	35.3	286	931.0	869.0
Huhhot	2,968.6	21.9	–13.4	–31.2	36.9	118	426.1	369.0
Uruumqi	2,622.3	25.7	–15.2	–32.0	49.0	161	194.6	126.3
Lhasn	3,019.3	15.2	–2.3	–16.5	27.0	136	453.9	446.2
Xining	2,793.5	17.3	–8.3	–21.9	32.4	128	371.1	331.9
Guiynng	1,395.0	23.8	4.8	–7.8	35.4	274	1,162.5	917.0
Kunming	2,435.5	19.6	7.6	–5.1	31.2	233	991.1	831.5
Nanning	1,837.2	28.1	12.7	–1.0	39.0	357	1,306.8	1,026.0

Table 2. Monthly temperature and precipitation in Hubei province (Date: 1960-1990)

Month		1	2	3	4	5	6	7	8	9	10	11	12	X
Temp.	Ave. temp. °C	3.1	5.0	10.2	16.1	21.3	25.6	28.8	28.5	23.1	17.4	10.9	5.4	16.3
	Max. temp. °C	8.3	10.1	15.1	20.8	25.9	30.0	38.2	39.1	30.1	22.9	16.2	10.4	21.2
	Min temp. °C	–0.9	1.2	6.2	12.0	17.4	21.8	25.2	24.7	19.4	13.1	6.8	1.2	12.3
Humidity (%)		76	78	80	82	80	79	79	78	80	79	78	76	79
Precipitation (mm)		30.9	55.1	97.1	140.4	146.2	179.9	136.8	102.0	82.0	64.8	53.6	30.4	1,019.2
Length of sunshine (hour)		130.7	119.8	128.3	147.8	179.3	206.6	264.6	274.6	185.7	176.4	143.8	137.0	2,094.7

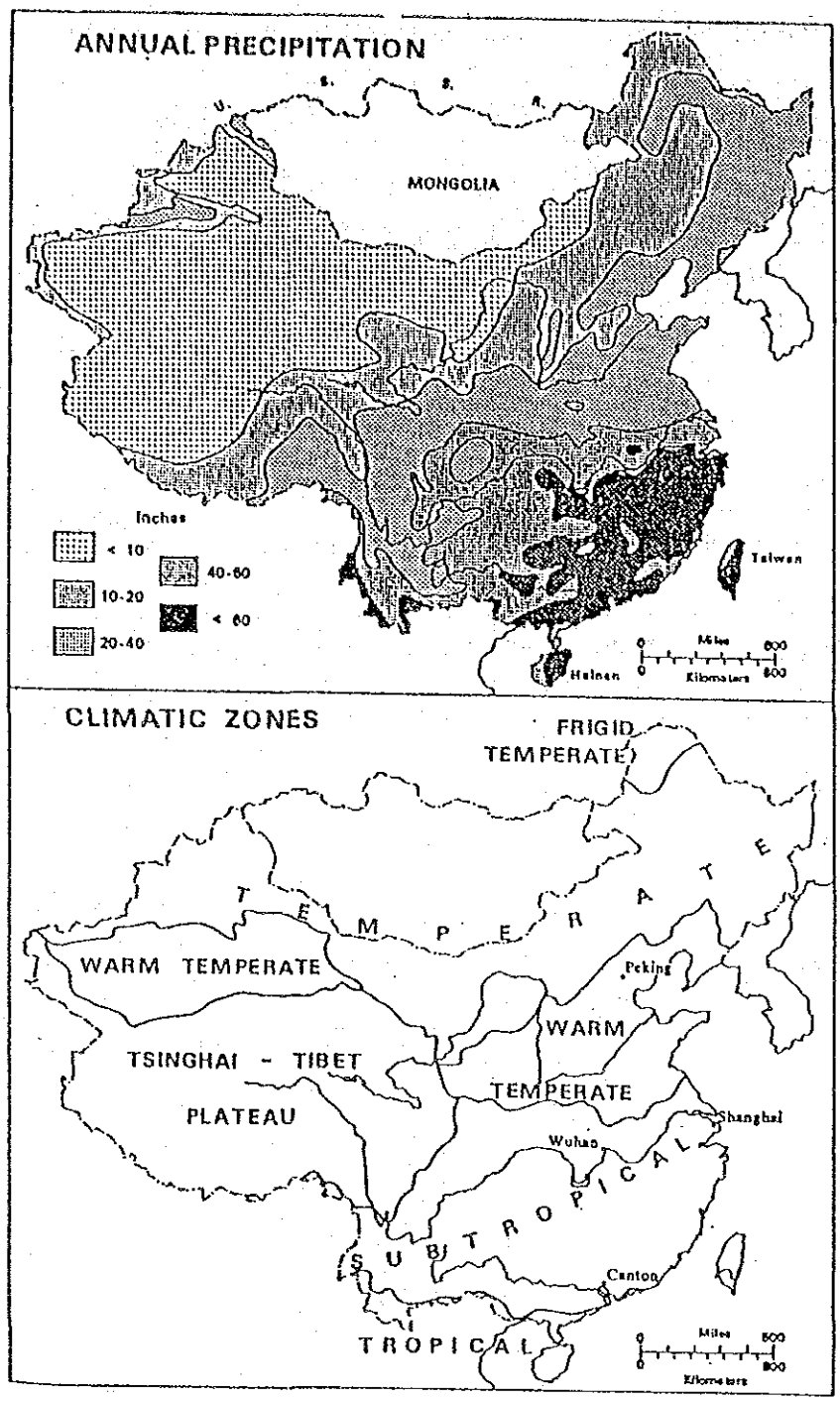


Fig. 4 Annual precipitation & climatic zones

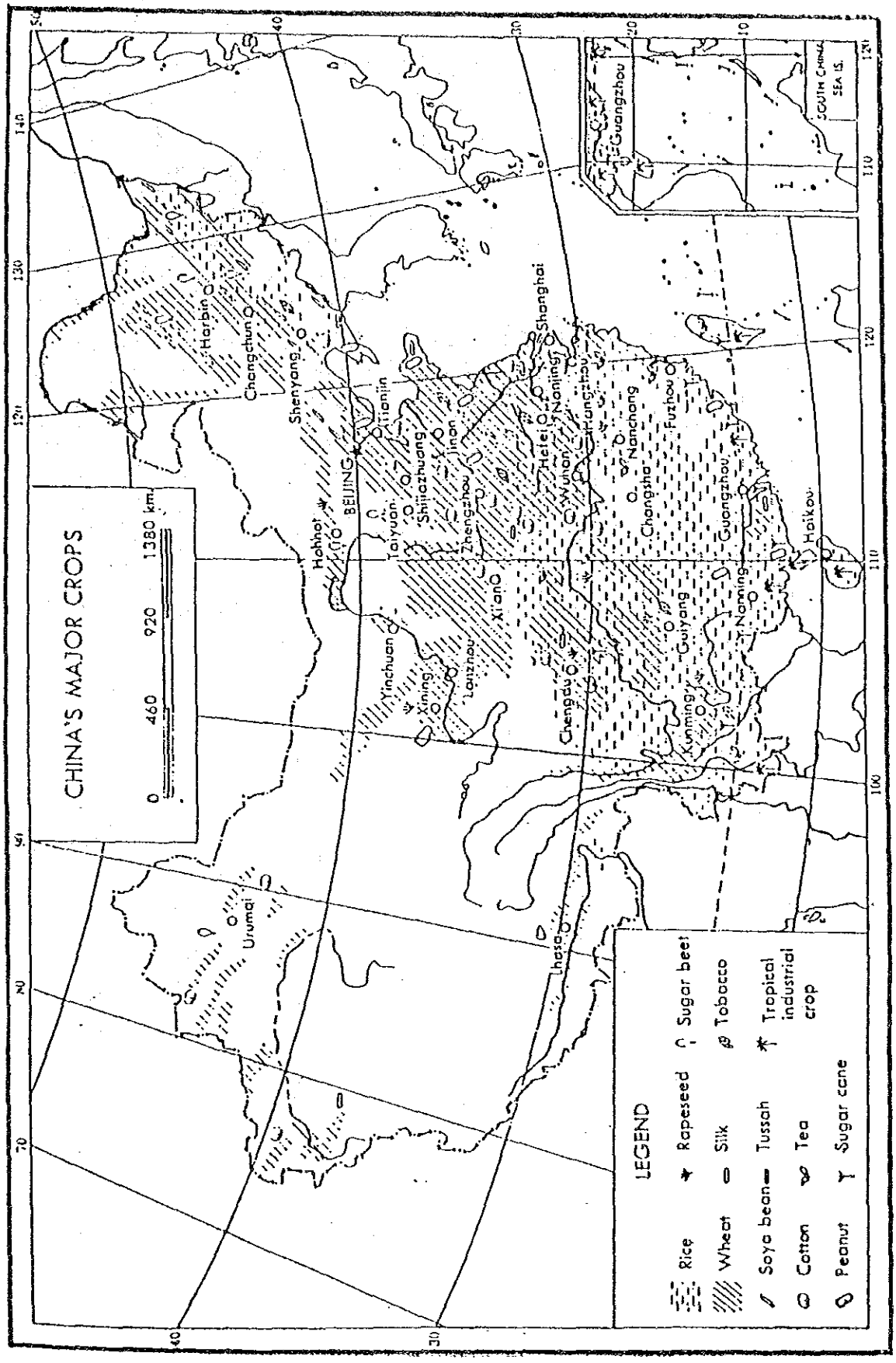


Fig. 5 China's major crops

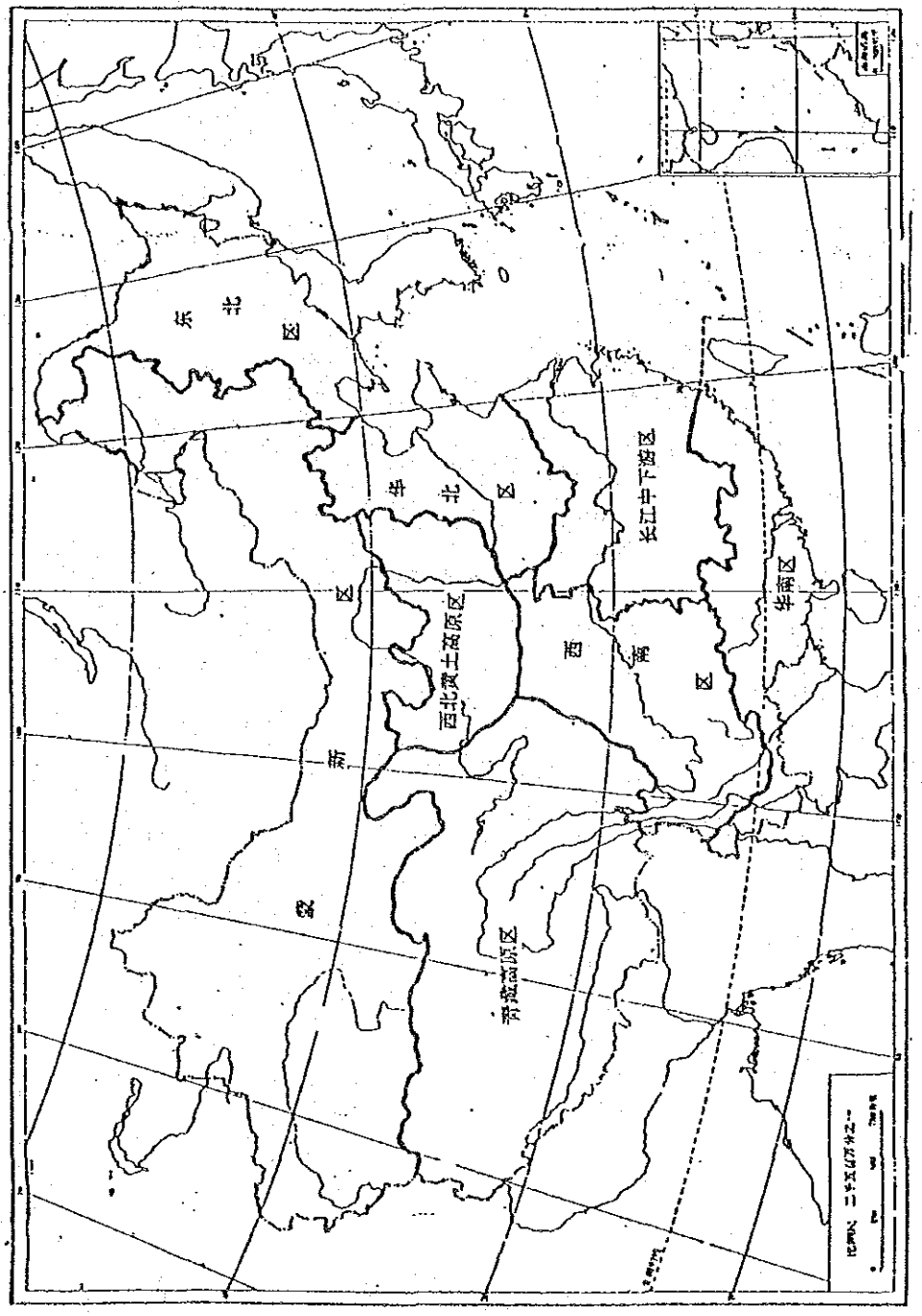


Fig. 6 The division f agro-climate zone

(3) Research, extension and production service and its network

In China, the agriculture research, technology extension and production service are under the control of the state council and the province government. The ministry of agriculture at the central level and the commission of agriculture at the provincial level are responsible for formulation and implementation of the agriculture plan, within the framework of the nation plan, and to supervise the execution of the plans and report results to higher authorities, and to propose new policies arising out of the problems faced during plan implementation. But the main task of agriculture sciences academy at the central level or provincial level are to conduct all kinds of research and experiments of breeding, crop culture, pest-decease control, soil improvement, new technology development and resource investigation. The ministry, commission and academy all have several divisions: grain and oil division, industry crop division, animal husbandry division, plant protection division, mechanization division, planning and finance division, science and education division, etc. There are full-fledged department (bureau, commission, institute or office) at prefecture, country and town level, only with lesser number of functionaries.

3. Vegetable Crops Production

(1) Major vegetable crops production statistics

The commonly cultivated vegetable crops in China are: chinese cabbage, cabbage, cucumber, tomato, pepper, watermelon, potato, eggplant, garlic, celery, onion, green chinese onion, chinese chive, spinach, bean and pea. Among them, the first five species are major vegetable crops. The total vegetable crop cultivation area is about 3.35 million ha, total yield is 101 million ton, average yield is 30 ton/ha, but the yield in different area differ greatly. Table 4, 5 shows the supply level in Wuhan and other major cities of China.

Table 3 Administration system and extension service network

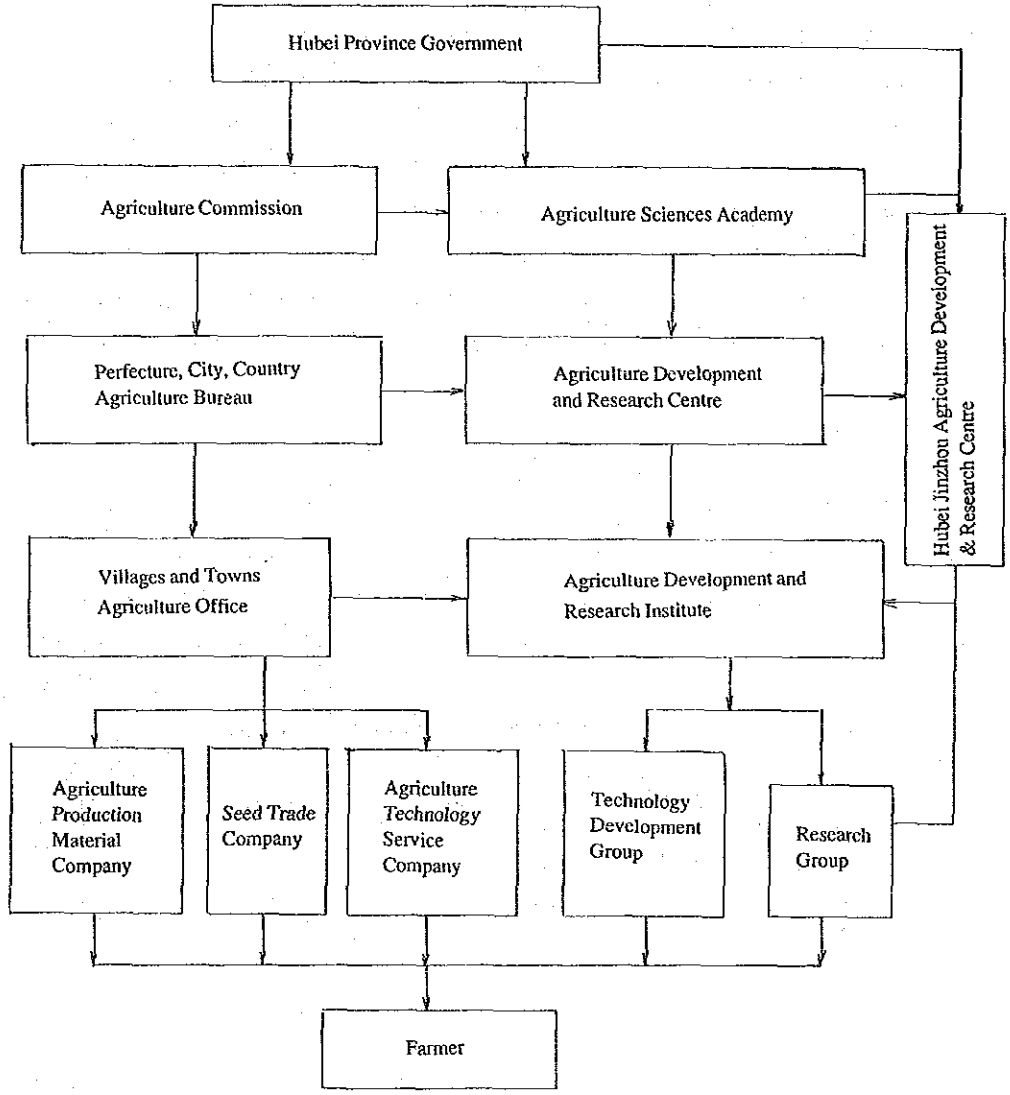


Table 4. Vegetable production area and its supply level in major cities of China

City	Vegetable area (sq. m/people)	Supply level (kg/people one day)
Harbin	93.3	0.51
Changchun	88.7	0.53
Shenyang	50.0	0.57
Ulumqi	43.3	0.37
Xian	31.3	0.37
Beijing	30.0	0.58
Tianjin	38.7	0.57
Zhenzhou	47.3	0.60
Shijiazhuang	47.3	0.60
Taiyuan	36.7	0.45
Wuhan	28.0	0.38
Hehei	19.3	0.29
Nanjing	28.0	0.43
Shanghai	20.0	0.36
Hangzhou	18.7	0.36
Nanchang	15.3	0.21
Fuzhou	22.0	0.36
Changsha	15.3	0.21
Chengdu	16.7	0.38
Chongqing	22.7	0.28
Kunming	24.7	0.47
Guiyan	21.3	0.17
Guangzhou	26.9	0.37
Nanning	26.7	0.35

Table 5. Major vegetable production in Wuhan

Vegetable species	Area (ha)	Output (ton)	Unit yield (kg/ha)
Legumes	13,500	202,500	150,000
Cabbage	13,320	399,600	30,000
Radish	9,030	541,800	60,000
Cucurbits	6,660	299,700	45,000
Others	15,580	183,000	

(2) Cropping system of major vegetable crop

In China, we usually cultivate vegetable crop four times a year: a) Spring under protection, b) Spring open field. c) Autumn open field and d) Winter protection. The cropping system is decided by the condition of nature and the physiological character of vegetable crop. In order to increase the output of per unit area, the cropping system usually is intensive cultivation.

(1) Crop rotation

There are two kinds of rotation way in China: one is the rotation of vegetable crop with cereal crop or cotton, another one is the rotation of vegetable crops, and the former is more and more adopted in recent years.

(2) Intercropping and interplanting

Intercropping and interplanting also called *stereoscopic-agriculture or ecologic-agriculture in China*, which is created by the principle of coexist-mutual benefit. In these kinds of cropping system, these crops which have different height or different physiological character can grow in the same field (coexist-growing) very well, with less cost, high productivity and more beneficial compared with other cropping systems. So, these cropping systems have been vastly applied now. For example: interplanting maize with potato, interplanting cotton with melon or pepper or greengram, intercorpping wheat with mushroom or chinese cabbage, intercropping garlic with kidbean, etc.

(3) Multiple cropping

This is a traditional intensive and meticulous farming cropping system. It is an efficient channel to increasing output and to realize period cycle supply. The common multiple cropping ways as follow:

a. Multiharvest in a year (in south or greenhouse)

For example: garland chrysanthemum - kidney bean - summer chinese cabbage - early autumn chinese cabbage - winter chinese cabbage.

b. Three harvest in a year (Yangtse River and Yellow River region)
For instance: chinese cabbage (radish, spinach etc.) - eggplant (pepper, cucumber, melon etc.) - kidney bean (celery chinese cabbage, spinach etc.).

c. Two harvest in a year (in north)
For example: welsh onion (onion) - radish (cabbage, chinese cabbage, celery etc.).

(3) Vegetable crop cultivation methods

Since China is a very large country and with 8 agro-climate zones, there are different cultivation methods in different area. Take Beijing as an example, the major vegetable crop and their cultivation shown in table 6. The date is only reference information, because of new technology (new variety, new cropping system etc.) can bring about new cultivation methods. Excepting the table, the general methods as follow:

1) Field preparation:
Cropping system choice, fertilizer applying to the subsoil and soil sterilization.

2) Cultivar choice
Hybrid F_1: cucumber, chinese cabbage, cabbage, watermelon, tomato, eggplant, etc.
Common variety: lettuce, cushaw squash, kidney bean, etc.

3) Sowing: seeds treatment and soaking, sowing in rows or bunch planting.

4) Raising seedling
We usually raise vegetable seedling in greenhouse which grows in early spring. In Shanghai and Beijing, some vegetables' seedlings are raised by hydroponic.

5) Planting
Planting spacings are list on table 6.

6) System management

a. Pests and disease control
There are many kids of pests, viruses, bacteria and fungi causing serious damage to vegetable crops. Pest control is usually done by using chemical insecticide, which is high toxicity to the pests but low toxicity to the plant and other life forms. In practice it is extremely difficult to achieve this combination. Disease control is done in similar ways to pest control. But now,

integrated methods are vastly adopted: a) resistant varieties, lots of new hybrids have been released recent years, b) seed treatment or seed coating, c) crop rotation, d) hinge on hygiene and healthy plant protection, e) soil treatment with chemicals.

b. Irrigation

In China, surface irrigation occupies 96%, sub-irrigation occupies 3% and overhead irrigation only 1%.

c. Fertilizer application

The crop of different species or planting in different condition (soil, season etc.) need different amount of nutrient elements like N,P,K etc. But the general application methods are that the more times and less amount for each time, the better for high yield. For example, like cucumber, usually 70% - 80% organic manure (about 75,000 kg/ha) and 30% inorganic fertilizer (super-phosphate 700 kg/ha) apply to soil before planting, and then, chemical fertilizer (150 kg/ha each time) and a little organic manure are used every 4-5 days, these chemical fertilizers are urea, ammonium nitrate, and nitrite potash.

Table 6. The major vegetables and their cultivation in China (take Beijing as an example)

Vegetable	Variety or cultivar	Time of planting	Spacing (cm)	Seed need (g/mu*)	Fertilizer application	Disease & pests	Time of maturity	Yield (kg/mu)
Chinese cabbage	Shandong 5 (hybird F_1)	8/10	65–75× 50–55	100–125	N1.0: P_2O_5 0.5	Aphid & virus D	11/10	5,000–7,000
Cabbage	Zhonggan 11	12/10	50 × 50	50–100	N1 : $P_2O\frac{1}{2}$: $K_2O\frac{1}{4}$		6/25	5,500
Tomato	Jinfong F1	3/20	60 × 25	40–50	N1 : $P_2O_5\ \frac{1}{2}$: $K_2O\ \frac{1}{4}$	Abnormal	6/20	3,500
Cucumber	Jinzha F_1 Jingyian 4	3/20 7/10	40 × 25 65 × 55	150–200	$N\frac{1}{2}$: $P_2O_5$1 : $K_2O\ \frac{1}{4}$	Downy mildew	5/1–7/5 9/10–20	3,000–5,000

Vegetable	Variety or cultivar	Time of planting	Spacing (cm)	Seed need (g/mu*)	Fertilizer application	Disease & pests	Time of maturity	Yield (kg/mu)
Pepper	Tonghuong F_1	3/25	50 × 25	150	$N\frac{1}{2}$: $P_2O_5$2 : K_2O1		5/10–8/5	3,000
Water melon	Jingxing F1 Zhenzhou 5	4/1–4/15	200 × 50	100–150	N1 : 0 : $P_2O_5$2.5 : K_2O 0.5		7/10–8/15	3,000–4,000
Potato	Zheng 2	3/20	60 × 25	400,000	N1 : $P_2O_5\frac{1}{2}$: K_2O2.5	Late blight	6/25	4,000
Eggplant	Shou 1 (F_1)	3/25	70 × 20–30	50	N1 : $P_2O_5$2 : K_2O 1.5	Wilt	6/20–7/10	2,500
Garlic	Chang-chuan Yunyin	3/10 or 9/20–30	16 × 10	50,000–65,000	1.0 : p_2O_5 1.5 : K_2O 1.2		6/25 or 6/10	1,000–1,500
Celery	Baimiano Yianqqin	6/25 or 2/5–3/5	13 × 10	1,000	N2 : P_2O_5 1 : K_2O 1		10/25–5/25 –6/5	5,000–6,000

Notes:

1. The date in the table is the reference information of major vegetable crop culture in open-field in Beijing area.
2. Because of most fertilizers in vegetable production in China are organic manure, fertilizer application can only give application ratio of N, P_2O_5 and K_2O.
3. 1 mu = 666.7 square meters

(4) Market system

There are several pathways from which the consumer can obtain vegetable products.

1) Wholesale markets: the wholesale market is usually state-run or collective economy. In order to operate efficiently, the price in wholesale market is usually lower and stable.

2) Retail markets: there are a lot of retail shops marketing vegetable products, ranging from the specialist greengrocer to the large supermarket.

3) Free markets: free markets are developing rapidly in recent years. This form of market is associated with large amount of products and a rigorous administration system and management rule, from which consumers can buy all kinds of vegetable.

(5) Major problems in vegetable crop production

There are many problems in vegetable production in China. But the major problems are: First, the fundamental construction of vegetable fields can't meet the needs of production; second, more and more population and less and less fields; third, the speed of technology researching can't suite to the production situation; the last is the technology of package, storage and fresh preservation development of which is very slow compared with other countries.

4. Hydroponic and Soilless Culture

It is in 1947 that the hydroponics and soilless culture arised in Nangjing city. But the self-design hydroponic and soilless culture system is in 1976, which was used for culture of watermelon by Shandong Agriculture College. Since 1985, the experiments and a little scale production of gravel culture, sand culture and hydroponic have been gradually conducted in Beijing, Shandong, Wuhan, Nangjing and Tianjig. For example, in Jianling village, Shanghai city, sand or rice husk are used for culture of seedlings such as tomato, cucumber and rice. The nutrient solution is made from fertilizers. The program, for tomato seedling culture is: sulphate of ammonia $(NH_4)_2SO_4$ 0.08%, triple superphosphate $Ca(H_2PO_4)_2$ 0.1%, sulphate of potash K_2SO_4 0.04%, sulphate of magnesium M SO_4 0.04%; for cucumber seedling is: $(NH_4)_2SO_4$ 0.06%, $Ca(H_2PO_4)_2$ 0.06%, k_2SO_4 0.03%, $MgSO_4$ 0.01%, PH 6.5 - 6.8. Afterwards, the NFT system and bag system are also adopted in these area. The average costs and outputs are shown in table 7. Up to now, the hydroponics and soilless culture area is about 5 ha.

Table 7. The costs and output of different

Culture	Cost (yuan*/mu*)	Yield of tomato	
		(kg/plant)	(kg/mu)
DFT	60,000	5.61	7,788
NFT	12,000	0.75	2,813
Gravel	3,000	1.52	5,700
Rock wool	3,000	2.30	6,906

Notes: 1.0 yuan = 25 yen; 1 mu = 666.7 m^2

Hydroponics and Soiless Cullture

Bambang Hardiantono
(Indonesia)

I. Introduction

Agriculture plays a very important role in Indonesia's national and economic development. It has also become a key area in increasing the income of the people. The country's agricultural development policies have shown encouraging results up to now, and these need to be maintained in the future. The policy of the Indonesian Government to increase food crop production has been carried out through intensification, extensification of land as well as diversification of food crops. In the 1983, equal attention is given to horticulture production, to support and improve nutrition, and diversify the pattern of food consumption, among the essential steps has been taken in this context was the establishment of the Directorate of Horticulture and the Horticulture Research Institute.

Indonesia is the largest archipelago in the world, with five main islands and about 30 smaller archipelagoes, and potential land for agricultural development is mainly found on the islands of Sumatra, Kalimantan, Sulawesi and Irian Jaya.

In the future the government sees on more balanced economic structure where the industrial sector will be as strong as agriculture. Ultimately, the industrial sector will develop into the backbone of the economy of the nation and self-sufficiency in food will be reached through intensification, extensification, diversification and land rehabilitation.

II. Natural Condition

1. Topography and vegetation

The groups of islands which make up Indonesia, lie between 94°15' East Longitudinal and 141°05' East Longitudinal, and between 6°8' North Latitude and 11°15' South Latitude. They are, therefore, entirely within the tropics.

The maximum length from west to east (Pulau Weh to Humbold Bay) is 5,110 km and the greatest north south distance is 1,888 km. The country map is illustrated in appendix 1.

The land area consists of 13,677 islands, of which 6,044 are named and 931 or 6.8% are inhabited.

The archipelago covers a total area of 4,497,214 km^2 of which 2,019,360 km^2 are land area. The average size of an island is 147.64 km^2.

The land area can be subdivided into three of terrain:

Type	Name and definition	Area (million ha)
I	Mountainous land (land at least 200 m above sea level)	65.5
II	Almost level to undulating and hilly (land less than 200 m above sea level and not belonging to group III)	50.0
III	Lowland (including swamps)	43.5

In Indonesia only 8% of the land area is used for agriculture, but 60% is forested and 25% serves other purpose, there is 7% of denuded and bareland. These are only some of the facts presented in table 1.

Table 1a. Land use in Indonesia

Land use	Absolute values in 1,000 ha	Relative contributions in %
Agricultural land		
- Farms	14,165	7
- Estates	2,226	1
Forested land	113,668	60
Denuded, bareland	12,661	7
Other land	47,734	25

Table 1b. Land utilization

Land use	Area (million ha)
House compound and surrounding	4,894,649
Bareland/garden, shifting cultivation	12,841,484
Steppe pasture	3,015,599
Duke	219,067
Waterpound	122,222
Preliminary land not utilized	9,730,472
Land with grown wood	19,989,764
Estates	9,473,899
Wet land	8,024,579

Source: The Central Bureau of Statistics (BPS)

2. Climate

Indonesia is characterized as an archipelago which has 2 main seasons dry and wet. Dry season extends from June until September, while the wet or rainy season begin from December to March.

The main characteristic of the Indonesia climate is the prevalence of monsoons, which brings to the whole country abundant rainfall for a wide range of agricultural crops.

Further distinguishing features of the climate are the high uniform temperatures and the great humidity. This general uniformity is caused by the moderating influence of the surrounding seas, but this does not exclude the existence of marked local differences, mostly caused by topographic dissimilarities.

The west monsoon lasts from December to about March, the east monsoons from June to about September. The change in the monsoons, the transitional period, happens approximately in April and November. The monsoons cause seasonal variations of the climate, which are relatively small in the northern parts of Indonesia, but pronounced in the south-eastern parts.

The temperatures varies between 21°C and 33°C, with an overall average of about 25°C. At low altitudes there is little variation throughout the year, the daily temperature changes are also small. The decrease in temperature with altitude ranges in Indonesia from 5.5°C - 6.0°C for a rise of 1,000 m. These are only some of the facts presented in table 2.

The coastal plains receive an average annual rainfall of over 2,000 mm, in the mountainous regions over 3,000 mm p.a. are recorded. The overall average precipitation is given to be 2,190 mm p.a. with range of 700 - 3,600 mm. These are only some of the facts presented in table 2.

The relative humidity is usually high. In most areas, the yearly minima are about 60%, and the maxima are about 90%, with an average of between 75 and 85%. These are only some of the facts presented in table 2.

Table 2. Average maximum-minimum temperature, precipitation and humidity in Indonesia.

Month	Temperature (°C)		Precipitation (mm)	Humidity (%)
	Max.	Min.		
January	29.06	21.17	324.5	84.52
February	30.86	22.81	220.96	82.88
March	31.88	22.94	242.43	81.6
April	31.47	23.64	212.08	81.57
May	30.55	23.38	161.46	80.58
June	32.04	23.08	170.01	79.54
July	31.83	22.35	69.97	77.04
August	31.67	22.14	119.59	75.76
September	32.26	22.56	115.45	74.92
October	29.75	21.99	152.27	77.43
November	28.04	23.62	227.47	80.46
December	30.95	21.48	307.8	83.74

Source: Meteorology and Geophysics Board

II. Agriculture in General

1. Administration system in agriculture

The organizational structure of Department of Agriculture is headed by a Ministry of Agriculture which is assisted by a Junior Ministry of Agriculture, also Secretary General of Department of Agriculture, Education and Training Board, Agricultural Research and Development Board and 4 Directorate Generals. The Directorate General of Food Crops Agriculture is the other one of Directorate General of Agriculture.

Under the Directorate General of Food Crops Agriculture, there are 7 Directorates and 1 Secretariat General and Directorate of Horticulture is the other one of Directorate of Directorate General of Food Crops Agriculture.

Directorate of Horticulture supervises 5 Sub. Directorates, i.e. Production Technology, Seed Production, Seed Control, Technology of Post Harvest and Natural Resources.

The organizational structure of Department of Agriculture is illustrated in appendix 2.

Directorate of Horticulture has a duty to carry out some of the main mission of Directorate General of Food Crops Agriculture based on operational policy, which emphasized by Directorate General of Food Crops Agriculture.

Sub. Directorate of Technology Production has a duty to collect and analyze data/information, plan production/supply and demand, and extension service on horticulture production technology.

In the regions, Directorate General of Food Crops Agriculture supervises 27 Provincial Agriculture Offices and under these Provincial Agricultural Offices there are 241 Kabupaten (District) Agriculture Services.

2. Extension service

In the extension program, the working area is divided into 'WPP' (Agricultural development Region) based on agro-climatic zones. Each 'WPP' is divided into "WKBPP' (Agricultural Extension Center Working Areas). Each 'WKBPP' consists of 10 to 15 'WKPP' (Field Agricultural Extension Working Area). Currently, agricultural extension areas in Indonesia consist of 88 WPP, 1.161 WKBPP, 17,843 WKPP and 239,762 'Wilkel' (Farmer Group Area).

Within each 'WPP', there are about 8 'PPS' (officers of Subject Matter-Specialists). Each 'WKBPP' is staffed by 2 'PPM' (officers of Senior Field Agricultural Extension Worker), and at each 'WKPP' there one to two 'PPL' (Field Agricultural Extension Workers). PPS, PPM and PPL employed by the Directorate General of Food Crops Agriculture. The available extension worker up to date area: 751 PPS, 1,501 PPM and 239,672 PPL.

In each WKBPP, there is one Rural Agricultural extension Center which serves as the center for all main extension and training activities. The center also serves as a place for field extension program which are oriented toward the achievement of production targets through improvement of technological recommendations.

Technological recommendation which are resulted from the trials Technological recommendation which are resulted from the trials carried out in farmers field are introduced to farmers through demonstrations. These demonstrations are carried out in various areas for different commodity of horticulture. It is hoped that, through these demonstrations, improved technology will be adopted by farmers.

Farmers are regularly invited for discussion and consultation with the extension workers at the Rural Extension Centers.

Field agricultural extension workers which mostly know nothing about horticulture except paddy and secondary crops, are also given training to upgrade their skill knowhow especially on horticulture.

Agriculture extension, these activities are also informal, conducted through the Agricultural Extension Center (BPP) and Agricultural Information Centers (BIP), devoted to informing farmers and their families, and

supporting their activities. Other means of extension are provided through audio visual system, such as radio, television, film, leaflets and others.

III. Horticultural Crops Production

1. Major horticultural crops production statistics

In the last 5 years (1985-1989) the production trend of horticulture is increasing substantially as indicated in the following table 3.

Table 3. Production, areas and yield of horticulture 1985-1989

	1985	1986	1987	1988	1989
1. Fruits					
Production (million ton)	4,158.3	6,128.0	4,965.6	5,857.0	5,222.1
Index (%)	100	147.4	119.4	140.9	125.6
Areas (million ha)	577.8	773.7	718.2	699.0	697.4
Index (%)	100	134	124.3	121	120.7
Yield (kg/ha)	7,196.8	7,920.4	6,914.0	8,379.1	7,488.0
Index (%)	100	110.1	96.1	110.43	104.1
2. Vegetables					
Production (million ton)	3,515.5	4,204.1	4,206.1	4,275.7	4,987.3
Index (%)	100	119.6	119.6	121.6	141.9
Areas (million ha)	1,050.6	1,241.1	982.3	1,289.9	871.4
Index (%)	100	118.1	93.5	122.8	83
Yield (kg/ha)	3,346.2	3,387.4	4,281.9	3,314.8	5,723.3
Index (%)	100	101.2	127.9	99.1	171.0
3. Ornamental plants (*)					
Production (million ton)	14.6	17.6	21.0	24.9	29.9
Index (%)	100	120.5	143.8	170.5	204.8

(*): Production in Jakarta, data in the other places is not yet available

However production of vegetables and ornamental plants is increasing substantially, but production of fruits tends to decrease.

Indonesia today orchids are cultivated mostly in and around big cities such as Jakarta, Bogor, Medan, Surabaya, Denpasar and other market center. Jakarta has been the major producer since the early 1950's.

Within the total development of vegetables, fruits and ornamental plants production during the last 5 years (1985-1989), the total production reached only 7,688.4 tons in 1985 from a total harvested area of about 1,628.4 ha.

In 1989, total production reached 10,239.3 tons with a total harvested area of 1,568.8 ha, which shows increase of 57.4% respectively.

The development of vegetables, fruits and ornamental plants production given obviously a rather good and high return according to both the demand and the quality required by the consumers.

2. Cropping system of major horticulture crops

Long growing seasons, small landholding, and high labor-land-ratios make multicrop production systems advantageous in Indonesia. Multiple cropping maximizes land productivity per unit of time.

The cropping system practiced in the valley depends on seasonal variations. Rice is the main crop during the rainy season. So, the cropping systems, including vegetable crops begin with rice.

The Indonesian traditional cropping systems can be subdivided into 7 of systems:

1) Mixed cropping

   Two or more vegetables, ornamental plants, fruit trees or secondary crops planted scattered.

2) Inter cropping

   Two or more crops, normally for vegetables, are growing in the same field at (or about) the same time.

3) Inter planting

   Two or more crops, normally vegetables with fruit trees, are growing in the same field at the different time.

4) Inter culture

   Annual crops, such as vegetables and several ornamental plants are grew between fruit trees, in rows.

5) Sequential planting

Two or more crops, such as vegetables or secondary crops, one after another, in the same field to maximize land productivity.

6) Relay cropping

The planting of a second vegetables before the first vegetables is harvested.

7) Alley cropping

Annual crops, such as vegetables or secondary crops grew between perennial crops, which perennial crops hedge plants and source of green manure.

3. Cultivation methods

1) Cultivar

Considering local adaptability, popularity and performance, the most common cultivars used by Indonesian farmers are:

Crop	Cultivar (Local name)
Fruits	
Durian	Sunan, Sukun, Petruk, Sitokong, Mas, Otong, Kani
Mango	Arumanis, Manalagi, Golek
Rambutan	Binjai, Lebak Bulus, Rapiah
Apple	Manalagi, Rome Beauty
Avocado	Ijo Panjang, Ijo Bundar
Grape	Probolinggo Biru, Bali
Carambola	Kunir, Kapur
Salak	Bali, Pondon
Sweet Orange	Tawangmangu
Mandarin Tangerine	Tejakula, Garut, Kacang
Banana	Ambon Putih, Ambon Ijo, Ambon Lumut, Badak, Rajasere, Barangan, Kepok, Nabgka, Tanduk, Agung, Kapas
Vegetables	
Potato	Cipanas, Cosima
Garlic	Lumbu Hijau, Lumbu Kuning
Shallot	Bima Brebes, Medan, Keling, Maja Cipanas
Tomato	Ratna, Intan, Mutiara, Berlian

Crop	Cultivar (Local name)
Amaranth	Giti Hijau, Giti Merah
Chinese cabbage	Granat Cipanas, Talaud, Sangihe
Long Bean	KP1, KP2
Kangkong	Sutera
Oranamental plants	
Orchid	Sorts of Vanda, James Storie, Apple Blosoom, Maggie Oei, Dendrobium, Nelly Morley

2) Sowing

Vegetables and ornamental plants seed soak in warm water, and the sun dry before sowing, Seeds should be sown immediately after land preparation. After 1 to 2 weeks, which seedling with 3-5 true leaves transplant. For fruit seedling with direct seeding.

3) Fertilizer

The application rate for various fertilizers is summarized in table 4.

Table 4 Fertilizer Recommendations and Schedules

Fertilizer	Time of application
Fruit	
Compost	Preplanting
N-P_2O_5-K_2O	Before and after rainy season
Vegetable	
Compost	Preplanting
N-P_2O_5-K_2O	15 days after transplanting and 10 days after head/flower initiation
Orchid	
N-P_2O_5-K_2O	Every week

4) Irrigation

During dry season, supplied with water 1-2 times, in the morning or afternoon. And during rainy season, drainage should be done.

5) Pests control

Diseases and insect pests must be controlled to ensure good yields of marketable. When applying pesticides, carefully follow the instructions on the label. Normally, for fruit trees, every two weeks and vegetables and ornamental plants, especially orchid every week.

For weed control, frequent weeding is necessary in furrows. Weeds in furrows sometimes become unmanageable, especially during the rainy season. In this case a non selective post emergence herbicide or manual method.

4. Marketing

1) Domestic market

Pattern of production, supply and demand of various vegetables, fruits and ornamental plants are highly influenced by the season. Therefore, the market supply in the peak harvest season is usually higher than the demand. There is also a great variation prices between each location.

The great difference in price between each areas in mainly due to the high marketing costs and high marketing risks.

In general, the marketing costs for horticulture in Indonesia are high, there are big differences between the retail price and the price received by the farmers. The price received by the farmer is about 20% or 60% of the retail price (depending on the type of commodities). The high marketing costs are mainly caused by the high costs of transportation, storage and the others. These costs are also increased by the fact that losses are high at post harvest level due to the poor handling method.

The highest marketing costs are incurred at collecting and retail level. In addition to the traditional marketing system, there is a need to improved the system providing the commercial products according to the demand of high income people living in towns, including foreigners. Commercial products are also marketed through supermarkets in large towns.

The main factors which hampers the efficient marketing system of vegetables, fruits and ornamental plants are the lack of knowledge about market situation and market development. Farmers and also traders are in need for proper information about price developments and parameters from other markets.

2) Export and import

Excluding petroleum and natural gas commodities, horticulture exports represented about 23% of total exports in 1987 and imports represented about 2-3% of the total import in 1987.

The export and import of horticulture are illustrated in table 5.

Table 5. Export and import of fruits, vegetables and ornamental plants 1987

Commodity	1987	
	kg	US$
Export		
1. Fruits	28,013,334	2,283,780
2. Vegetables	83,353,616	10,899,471
3. Ornamental plants	303,578	164,669
Import		
1. Fruits	3,870,865	2,771,314
2. Vegetables	32,644,902	15,971,882

Source: Directorate General of Food Crops.

The policy of Indonesian Government is to increase the exports of non-petroleum and non-gas commodities and to reduce imports in order to save foreign exchange. In order to reach this governments policy. The following steps have been set up:

a) To increase horticulture production

b) To develop processing industries and improving post-harvest activities to substitute imports and increasing exports.

c) To stimulate private sector in order to incase capital investments in the horticultural sector

d) Simplify export procedures, improve marketing facilities and other incentive measures to stimulate export.

5. Major problems in horticultural crops production

The main problem of horticultural production in Indonesia are listed below.

1) High production costs

Most of the commercial horticulture face high production costs. This is due to the improper application rate noted earlier is considered to be very high. Further research is needed.

2) High seed/seedling price

Most seed for high yielding varieties is imported. Therefore the price is relatively high forcing small farmers to use local seed/seedling. Low yields and poor quality have resulted.

3) Transfer of technology

The transfer of technology has produced the following problems:

- show progress in the adoption of recommendations by the farmers
- the limited skill and know how of the extension workers.

4) High marketing cost

In most cases farmers obtain a low share of the customers price. This is the consequence of the inefficient marketing system. Some of the shortcomings of the system are poor marketing organization, high losses due to improper handling, poor infrastructure, and high transportation costs due to small scale and scattered farms.

V. Hydroponics and Soilless Culture in Indonesia

Hydroponics/soilless culture introduce in Indonesia since at the end of the 1970's and by the 1982-1983 was being developed in Indonesia during the last 7 years, essentially, there are 3 types of hydroponics systems, i.e.:

1) Liquid system, which have no supporting medium for the roots.

2) Aggregate system, in which the roots are supported by inert media, such as peat, perlite, sandy or husk ash.

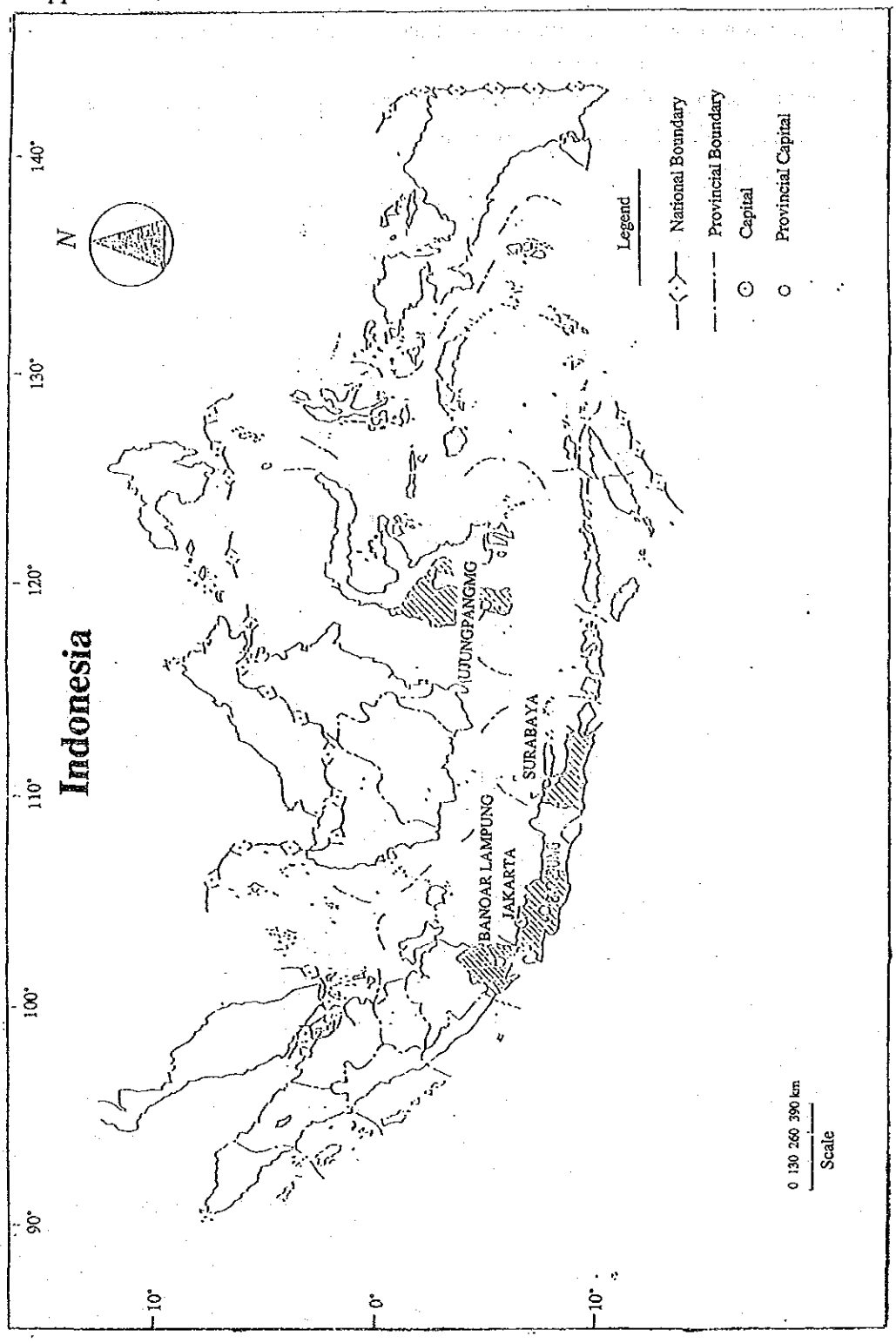
Nutrient solution of Liquid and aggregate systems, normally, are recovered and replenished and used trough, bag or pot as container.

3) NFT system, known in Indonesia since the 1985. Crops are grown, based on the use of rock-wool as a substrate and lied in gully. Nutrient solution from the catchment tank with the pump flows into gully. During in gully nutrient solution were absorbed by plants. Then, nutrient solution which not absorbed, it is pumped up again to the top of the gullies.

The pH and nutrient solution status of the solution in monitored, and modifications made as required.

Until now, in Indonesia, hydroponics farmers have been using system as follow: NFT system one farmer, Aggregate system many farmers, liquid system some farmers.

Appendix 1.


Indonesia
N
Legend
National Boundary
Provincial Boundary
Capital
Provincial Capital
UJUNGPANGMG
SURABAYA
BANOAR LAMPUNG
JAKARTA
0 130 260 390 km
Scale
90°
100°
110°
120°
130°
140°
10°
0°
10°

Appendix 2.

ORGANOGRAM