"THE PRESENT STATUS AND FUTURE POTENTIAL OF SNAP BEANS IN CHINA" by: GUY HENRY and LI PEIHUA*

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Introduction:

In order to assess the economic potential for snap beans (Phaseolus vulgaris) in the People's Republic of China, several research activities have been initiated. These include both primary and secondary data collection on agronomic and economic aspects of snap bean production and consumption. Several Chinese research institutes are currently collaborating with CIAT in these endeavours. The subsequent expected results will serve to document the relative importance of China both in terms of priority area as a country, as well as for specific research issues. As a consequence this paper will only attempt to document the current place snap bean cultivation holds with respect to general vegetable production in China. Furthermore, current constraints and future potential for snap beans in China will receive attention.

The organisation of this paper is as follows: The following section briefly discusses some historical aspects of Chinese agriculture and vegetable cultivation in particular. Then follow sections on production (costs), marketing and consumption aspects of snap beans. A discussion on the current constraints and future demand of snap beans in China will conclude the paper.

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Vegetables in China:

China's 1.1 billion inhabitants attempt to feed themselves on an estimated 100 million hectares of "land under cultivation", or 0.1 ha per capita (Table 1). Not only is the land constrained by quantity, also by quality. Huge areas are subject to severe soil, wind and water erosion. However, a 7,000 year old agriculture history, together with Chinese engenuity and hard work have enabled the people to cope with the limited natural resources. Moreover, Chinese farmers have developed agronomic techniques, based on efficient re-allocation of resources, that nowadays enable them to produce some of the highest yields per hectare in the world (Wittwer et.al.,1987).

Besides rice, vegetables are the most important food group in the Chinese diet and form the major source of protein, minerals and vitamins. Vegetable production has always played an important and unique role in Chinese agriculture. In cultivated area however, vegetables constitute less than 4% of total planted area. It is estimated that some 5.3 million hectares are under continuous or seasonal vegetable crop cultivation in China (China Agriculture Yearbook, 1987). This area generates an annual production of some 100-150 million MT of vegetables. An accurate number is not feasible since vegetable consumption data of rural areas are non-existing. However, a study of 35 major cities (totalling 56 million inhabitants) indicated an average annual urban vegetable consumption of 185 KG/cap.

(FAO, 1988). Given that rural vegetable consumption is lower than urban consumption (Table 2) and given that 80% of the total Chinese population is rural, the above-mentioned estimate was derived at.

It is estimated that approximately 160 different vegetables from 125 species are grown in China today. The Chinese are very resourceful in eating habits. Hence, different parts of each plant are consumed for food. As such, 60% of the species are leafy vegetables, 37% fruit vegetables, 30% stem vegetables, 16% seed vegetables, 7% root vegetables and 4% flower vegetables (Wittwer et al., 1987).

Vegetables of the Brassicacea family (B. chinensis and B. pekinensis) or "Chinese" cabbages are most important in China. They are cultivated in most regions as the #1 vegetable. Besides the high annual yield (up to 75 MT/ha) and low price, this vegetables is popular for it keeps well in storage during the winter months.

In China green beans are divided in snap beans and yardlong beans (Vigna sesquipedalis), or in Mandarin called, "ts'ai-tou" and "chiang-tou" respectively. Map 1 and 2 show the geographic production areas of the two species. It can be seen that snap beans are grown in most areas except for the North and North-West. In contrast to the former, yardlong beans are concentrated more in the tropical coastal region but only scarcely North of the Po-an-he river. Again, no macro data exists for these vegetables. Hence, estimations were made based on the assumption that three-fifth of

total green bean area consists of snap beans and two fifth of yardlong beans. Additionaly, it is assumed that urban green bean consumption is higher than rural consumption. Data from one specific city, Beijing (BVRC, 1986), suggest that green beans are cultivated on 12% of total municipal vegetable acreage (Table 3). Average yields are 12-20 MT/ha. Extrapolation for total snap bean production in China would then be 4.8 million MT. (calculated for 15 MT/ha yield). Alternatively, one can calculate, starting with an estimated snap bean consumption of 2.2 KG/cap. and dereive a total annual production of 2.2 million MT. Since these calculations are based on 1985-86 data, a 1988 Chinese snap bean production estimate, may be in the range of 2.5-5.0 million MT.

For several reasons, vegetable cultivation in China differs from that in the US, Europe or other LDC's. Over centuries the Chinese have developed highly specialized agronomic techniques (through usage of a very high labor/land ratio) to minimize climatic, soil and biotic constraints. Some of these unique techniques are (Wittwer et.al, 1987): 1/ Seedling transplanting is used for many species of vegetables. This technique decreases the vegetables growing season (in the field) and subsequently increases the cropping index (# crops/year/ha). 2/ Climbing varieties of vegetables are being optimally utilized in order to increase the leaf/area ratio (ratio of leaf area per land area). 3/ Bed culture, vegetable seed beds separated by

ditches or furrows and used with specific intercropping, optimizes available space. 4/ Intercropping is a widely used concept that includes mixed, relay, strip and hill cropping. Varieties of different season, height, leaf type and maturity are intercropped to increase yield per unit of land. 5/ Mulching with sand, rock, straw or plastic is widely used, especially in the more arid regions. Its advandages are numerous and with the increased popularity of plastic usage has become even more important. 6/ Fertilizer use is probably the key aspect of succesful vegetable production in China. Relative poor soils are being transformed into high producing media by supplementation of enormous quantities of human and animal waste, city garbage, compost and chemical fertilizers. The last and most recent innovative aspect is 7/ hybrid seed utilization of especially the cabbage varieties. It improves yield, uniformity and disease resistance. Moreover, under Chinese conditions it has proven to be economically feasible. Integration of the aforementioned aspects have resulted in a highly productive and efficient utilization of the available resources in vegetable cultivation.

Snap bean production aspects:

It must be noted first that it would be naive to assume that a huge and diverse country as China would only produce one kind of snap bean. Evidence exist that almost 2,000 snap bean germplasm accessions have been collected to date

(Li, 1988). Physically, snap beans in China differ in pod type (long and round to short and flat) and color (from white to dark purple) and in plant habit (both bush and climbing type). Seed color also ranges from white to almost black. In general, one can observe that the "French" type snap bean, prefered in Europe and the US, is only produced in China for (canned) export purposes, but is not prefered by the average Chinese consumer.

Climatic conditions dictate to most extent the number of snap bean crops per year. On the average 2 cycles can be grown in China. In the South, the summer is unrestraining, while in the Central/Eastern regions, the winter is the limiting period (Beijing has 183 frost-free days). In the North China Plain snap beans can only be grown during the short summer season. In the temperate climate regions, the use of green-houses, plastic tunnels and seedling transplantation has increased the cropping index to 2.3-2.5. However, for the tropical South the introduction of heat-resistant varieties could only improve the cropping index. Here, yardlong beans are grown during the hot/humid summer period (Plucknett and Beamer, 1981; Li, 1988).

Numerous intercropping combinations exist with both climbing and bush type snap beans. Some more popular (and traditional) combinations are: snap beans/spinach/cabbage, snap beans/garlic/eggplant and Kohlrabi/snap beans/garlic (Chen, 1988, Hu, 1988). In the South, intercropping of bush snap bean with sugar cane is practiced (Henry, 1988).

Also, intercropping of bush and climbing beans seems to be practized (which has also been observed in Turkey). It is of interest to note that at times, when due to unfavorable weather conditions, a preceeding crop cycle has lagged, bush beans instead of pole beans are planted because of their shorter cycle. Climbing type snap beans are staked with a/ single (bambu) stake, b/ tetrapod type c/ A-frame type, and d/ straight trellis type.

In the Beijing area spring planting (in the field) starts in April (as soon as temperature allows). However, planting in glass or plastic houses (tunnels) can start already in mid-March. Fall planting starts at the end of July. There will be either direct planting of 3-6 seeds per hole or seedling transplanting. The high number of seeds (bush type: 90 KG/ha and climbing type: 70 KG/ha) is an insurance for a high germination rate. Plant beds will have been prepared of 6-9 mtr. long and 1.3-1.5 mtr. wide, enclosed by irrigation ditches/furrows. Each bed will contain 3 rows in the case of bush type and 2 rows in the case of climbing type. Distance between plants is 0.22-0.25 mtr.

Fertilizing starts with the preparation of the soil. Animal manure and (human) night soil are mixed in with the soil, up to 50 MT/ha. In addition compost is added to the amount of 30-50 MT/ha. At the different development stages of the plant (leaf sprouting, flowering and fruit setting), additional organic and chemical fertilizers are applied. A common practice is to mix the fertilizer in the irrigation

water and manually "ladle" this mixture onto the plants. Subsequently, another 30 MT of night soil and 200-375 MT of chemical fertilizers will be applied. It is a well recognized threat that "heavy metals" from night soil applications on leafy vegetables present a potential danger for human health. However, no conclusive evidence has yet been presented of similar repercussions with fruit vegetables, like snap beans (Lynch, 1989).

Irrigation in this region is done by flooding, and the frequency depends on natural precipitation and timing of fertilizer applications. Weeding (by hand) seems to be done continously. As a result vegetable plots look extremely clean and well-kept.

Disease and pest control are a combination of ancient traditional (what now is called "IPM") practices and modern chemicals. The objective like anywhere else, is to minimize yield losses and market a high-quality (unblemished) product. Common diseases that have been reported in snap bean cultivation are (Li, 1988; Hu, 1988; Yang, 1988; Chen, 1988; Plucknett and Beamer, 1981; Williams, 1979): Root rot, Downy mildew, Anthracnose, BCMV, Fusarium and Bacterial Blight, and Rust. Common insect pests are: mites, white fly, bean fly and leaf miner. The Chinese philosophy to control pests and diseases is based on prevention. As such, pest monitoring devices (light traps, yellow plastic strips coated with glue, and various baits) are placed in and/or near plots. For centuries traditional cultural

practices have been used like, continuous crop rotation, deep plowing and leaving fallow in the winter (Northern regions) and flooding for rice rotation (Southern regions). In addition, after harvest, farmers meticuously clean their fields of plant debris (and feed it to the hogs). For certain specific insects, biological control has been practiced. However, not in the case for insects common in snap bean cultivation (Chen, 1988). Both in the North-East and South, snap bean farmers apply frequent (every 7-14 days) pesticides (more specific data will be forthcoming from a diagnostic study on chemical control practices, currently being executed by BVRC in collaboration with CIAT). Supposedly, farmers are aware of the toxicity of chemicals on vegetables. However, this has not been a detergent from using, among others, organophosphates, dichlorvos, Dimethoate, Malathion, Zineb and "Bordeaux mixture". Also, hardly any personal protection is being used while handling pesticides (fumigation by hand or motor pumps).

Near Beijing (spring) harvesting commences 60-70 days after planting and consists of 6-8 pickings, while in the fall it starts some 10-15 days earlier. Bush beans mature within 45 days and allow 3 pickings. Differences with the South, besides different planting dates, are a longer spring growing season and a higher number of pickings (every other day for 30 days) per harvest. It may be of interest to note here that farmers have the practice to pick all beans during the first harvest, so that during subsequent

pickings most beans are uniform (same maturity). Reported yields may not be quite accurate, since most beans are intercropped. However, in the Beijing region yields for pole beans are an average of 15 MT/ha, while bumper crops of 22.5 MT/ha are occurring quite frequently. Probably these latter yields are being produced in greenhouses or plastic tunnels. Similar yields are being reported for the more tropical regions. But typically, fall harvests yield considerably less (10-15 MT/ha). No yield data has been collected for the North and North-East. Data from the South on bush beans show average yields of 7.9-10 MT/ha. At least in the South, these relative lower yields are the major reason why bush beans are not very popular except for the Nanning and Sianghai regions where French type bush beans for (canned) exports are produced on contract at a (higher than the market) fixed price (Yang, 1988). However, it has been reported that the popularity of bush beans in the Northern regions (not traditionally snap bean regions) is increasing. The argument being that these areas show more "extensive" crop production and less labor per land unit is available (Li, 1988). Some 50% of Northern vegetable production will be stored on-farm to be kept for a 3-5 month during the winter season. Typically, cabbage, potato, turnip, onion, radish and garlic stalk are stored (semi) underground in pits covered with straw or sand. However, no storage for fresh beans is practiced (Pluchnett and Beamer, 1981).

Cost of snap bean Cultivation:

Production costs for snap beans have not been published. However, a recently held survey by the Agricultural Economics Department of the South China Agricultural University has generated information on vegetable production costs (Tan and Siao, 1988). It should be kept in mind that the precented figures were calculated for one year of intercropping of 6-7 vegetables. As such, it can only serve as an approximation for snap bean production costs. Table 4 shows the cost shares for inputs and labor. Table 5 presents the calculated benefits of vegetable production.

Labor embodies the major share of production costs. Almost 4,000 man days are required per hectare which constitutes 70% of total costs. This share is almost double of most other LDC's. As part of labor, marketing costs almost a third or 1,300 mandays. So it takes 3.6 persons a year to market the produce of 1 hectare. Also, pesticides application requires 15,7% or it takes 1.7 persons a year to fumigate a hectare of vegetables. The major share of inputs is taken up by fertilizer (almost 50%), while pesticides account only for 8.6%. Table 5 calculates a Net Income (per hectare, per year) of 38,130 YUAN or US$ 10,305. However the average vegetable farm in South China, which can be operated by a "modern" family of three is only 0.11 HA (1.7 mu). Subsequently, the average farm income is 4,321 YUAN (US$ 1,168). When an average labor wage is only 2,000 YUAN (US$ 540) per year, one can conclude that vegetable

farmers are doing relatively well. This is consistent with the notion that traders and vegetable farmers are becoming the rich middle class in modern China.

Land rent has not been included in the production costs. Although farmers in general have to pay an annual "land tax" of 10% of total revenues, since the beginning of 1980 vegetable farmers have been exempted of this as an incentive for increased vegetable output (Tan and Siao, 1988). The new Chinese philosophy is however unprepared to deal with certain free-market phenomena like land values. All land belongs to the State, but farmers (in contrast to urban workers) have acquired a certain property right by being able to generate considerable revenues from the land. Since there is no trade in land, there is no price for land and non-farmers cannot acquire land to start farming (a value for land was reported, when land was "expropriated" for a rail road, of 20 times the annual expected revenues per land unit (Tan and Siao, 1988)). This inequality issue may create discontent among non-land holders and will need more attention in the future.

Snap bean marketing aspects:

Since the beginning of the 80's changes in the political philosophy of the Chinese leaders have resulted in a rapidly changing economic environment (among others). The new trend of a "market-driven responsibility production program" dictates that although land is still owned by the state, farmers are responsible for its maintenance and

production (Wittwer et.al., 1992). The consequences for agriculture and specifically, vegetable production and marketing have been significant. Although one may not contribute everything to this new program, during the 80's agricultural production has risen by 8% per year, as the result from both increases in crop area and yield. As such, vegetables sown area increased by 68% between 1980 and 1986 (FAO, 1988). While before the "turn-around" vegetable production and marketing was almost exclusively a State - run affair, currently 90-95% of vegetables are produced by private enterprise and marketed at "free markets" (Tan and Siao, 1988).

Before 1980, vegetables were produced by a system of communes, brigades and teams (and only to a small extent by private "home gardens"). Every municipality had a Vegetable Company (resulting under the Municipal Revolutionary Committee) coordinating supplies from the production units to the urban marketing network. For example, Beijing counted 24 semi-urban communes (consisting of 223 brigades) supplying vegetables. Some 70% of these were contracted with particular urban marketing clusters. The latter resulted under 8 major Food Markets that were responsible for the marketing in specific districts. However, the communes on contract with a specific cluster did not supply through the Food Market, but delivered their produce via a "weighing" or "linking" station directly to their cluster. Cluster were responsible to supply smaller markets and

other retailers (Plucknett and Beaver, 1988). Many variations of this basic concept existed for different cities. This very centralized system suffered from many inefficiencies that resulted in, times of waste (oversupply) and times of long waiting lines at the vegetable counter (undersupply), since prices were fixed.

Vegetable farmers have rapidly adjusted to the new free-market oriented policy and according to several sources, only a fraction of the former state-controlled centralized vegetable system is still operating. Although the new and old system co-exist, consumers prefer the free markets because of lower prices, better quality and larger variety of products. Marketing, has become more efficient since currently the major part of total volume of vegetables goes directly from producer to market. Farmers sell to the free market or to peddlers or sell directly to the consumer.

Comparison of farm-gate and retail prices for vegetables in Beijing (October, 1988) indicate an average 10-20% marketing margin. If this would prove to be consistent, it would be the lowest margin of any other country studied by CIAT. More detailed information on market flows cannot be presented yet but will be generated by a current collaborative study between the Institute of Economics of CAAS in Beijing and CIAT.

Snap beans are priced in the middle range of vegetable prices, as observed in October 1988 in Beijing (Table 6) at US$ 0.27/KG. Remarkable is the relative low price for

cabbage and high price for yardlong beans. The former, to some extent, can be explained by the fact that almost 75% of total Chinese cabbage supplies are marketed during October to December (FAO, 1988), subsequently prices during this period must be depressed. The latter can be explained by the fact that yardlong beans are out of season in October in Beijing. Therefore these beans had to be imported from the South and subsequently were priced higher.

Snap bean consumption aspects:

The Chinese dereive 80% of total food intake from grains, root & tuber crops and soybeans. As mentioned earlier, urban vegetable consumption is estimated at 130 KG/CAP (FAO, 1988), while average total Chinese vegetable consumption is estimated at 134 KG/CAP (China Agriculture Yearbook, 1987). An extrapollation from different information (FAO, 1988, BVRC, 1986, Chinese Agriculture Yearbook, 1987) derives percentage shares of vegetable consumption in Table 7. (Chinese) cabbage (the major contender of the leafy vegetyables) takes up a 50-60% share of total vegetable consumption, while green beans account for 4-5%. The latter is part of a group of vegetables (radish, eggplant,celery and cucumber) that show similar shares of 3-5%. One should take into account here though that leafy vegetables like cabbage, during preparation, loose almost half their weight. The Chinese housewife is very much aware of this.

Vegetables are essential in any traditional Chinese dish and are used in each of the three daily meals. Like an Argentine cannot cook without beef, a Chinese cannot cook without vegetables. Typically, vegetables are prepared by stir-frying quickly at a very high temperature in a wok with a bit of oil (sesame, peanut, soybean or sunflower). As such, loss of vitamins and taste are minimized, and at the same time, the temperature ensures adequate sterilisation. In addition this process does not require much fuel. Hence, since dry beans require a long cooking time, they are only used to a small extent as an ingredient for soups, porridge and pastry-filling. It does not fit in with stir-frying. However the storability of dry beans is well recognized. Over centuries Chinese cooking traditionally has evolved in a very efficient process that utilizes resources as efficiently as possible.

China has a long history of natural medicine. Hence, the housewife very much emphasizes the wholesomeness in her decision to purchase different vegetables, besides taste, quality and price. Although no data exists, it is hypothesized that, with current average household purchasing power, the income elasticity for vegetables should be average to low (and relatively higher for rural than for urban households). However, at the same time the elasticity of substitution among the vegetables should be high. With rising disposable incomes and more varieties of vegetables available almost all year round (infrastructure is improving and subsequently interregional trade is

becoming more important) the Chinese will probably start to substitute leafy vegetables (cabbages) for more fruit and other vegetables. It should be taken into account here that currently some 10-20% of all vegetables are processed (pickled, brined, dried, etc.) and that in the North almost 50% of total vegetable production is stored for up to 5 months. Also, given income growth, vegetable protein sources, to some degree, will be substituted for animal protein sources (fish, poultry and pork).

Current constraints and future potentials:

Although Chinese urban snap bean yields may seem, relative to other countries, quite high, there still are several constraining production factors. The first of all, and probably the most severe, is the pests and disease pressure in snap bean production. As a matter of fact, this has proven to be a major universal production constraint (CIAT, 1989). Heavy insect and disease infestation implies frequent pesticides applications. Farmers use varieties of "cocktails" (fungicides and pesticides mixtures) that often contain heavy toxic chemicals that may not even be very effective and/or efficient. Besides the direct input (chemicals) and labor costs, the indirect costs of the danger to human life (because of the toxicity of the chemicals in handling and as residues in the crop) is of a major concern. One of the causes for disease occurance is the sub-optimal seed quality. A clear picture of the distribution of vegetable seed is not possible. However,

interviews of farmers reveal that seeds are generally exchanged among themselves.

Another factor that up to the present hasn't seemed to be severe but may be constraining in the future, is labor. As previously was shown, it takes almost 4000 man-days to cultivate a hectare of (6-7 crops of) vegetables a year. However, in the future less-labour intensive crops may be getting more attention. Hence , bush type snap beans may have a significant potential.

Besides the above factors that constrain production in a micro sense, production is also constrained in a macro sense i.e. by season and by topography. As was discussed earlier, the Chinese are utilizing the available growing season as efficient as possible (seedling transplanting, plastic tunnel cultivation and mulching). Since one of the major objectives is to increase the crop-index, an urgent desire for introduction of early maturing vegetable varieties (with cold resistence for the North and heat resistance for the South) remains.

Moreover, there is a drive for vegetable area expansion. This is ocurring at two levels. An increased vegetable demand and simultaneous urban expansion are pushing traditional semi-urban vegetable production areas to the countryside. Hence, in the future, vegetables will be increasingly produced in the peri-urban and outer areas. In addition, whole new regions where little tradition of vegetable cultivation exist, are being transformed into

major vegetable production areas (i.e. North/North-East).

So far, an overview of both agronomic and economic aspects of snap bean cultivation has been presented. In addition the major constraints to current production have been identified. The question that remains is how the future demand for snap beans will develop and what needs to be done to meet this demand. The current Chinese population of 1.1 billion people is reported to grow at a rate of 15 million a year (World Bank, 1988). At the same time urban population is annualy increasing by 2.2 million and since 1982 GDP has risen by an annual 9.5% (TAC Secretariat, 1988). Unfortunately, income elasticities for snap beans (for rural and urban areas) have not yet been generated. However, given the aforementioned dynamics and assuming that current annual snap bean consumption is 3.5 million MT, snap bean consumption for the year 2000 is estimated at some 5 million MT. In order to satisfy this future demand some recommendations on production increase strategies are suggested:

1/ Vegetable crop area must be expanded. Possible new areas are in the North/North-East. Less-intensive cultivation should warrant an increased potential for fresh snap beans.

2/ More research is needed, first of all, to diagnose the effectiveness and efficiency of current pest and disease management practices. Secondly, to propose alternative practices. As a result, production costs may be lowered

(and the danger to human health may be diminished).

3/ The introduction of earlier maturing varieties, of which some should have cold resistant characteristics and others with heat resistance, could increase the crop index for the existing vegetable areas. In addition, new areas with less favorable climatic conditions could start to grow these varieties. Hence, breeding work with these objectives in mind should be emphasized.

4/ Some post-harvest research on green beans has been conducted at BVRC in Beijing. However, additional work is needed to develop techniques that will improve the storagability of this vegetable. If quality can be maintained for a longer time period, this may benefit the interregional trade of the fresh product, besides the daily benefits the consumer derives from this improvement.

This paper has attempted to present an overview of the snap bean situation in China in order to quantify and qualify the economic potential of snap beans in China. It can be concluded that snap beans in China do have a significant potential. This vegetable holds a well established (traditional) place in the Chinese diet. Moreover, it is recognized as a tasty, wholesome vegetable, that, given projected income increases, may probably capture a larger share of the vegetable basket. In addition, it is produced by small farmers who view it as a profitable crop. Increased combined research efforts can have a significant impact on this development.

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TABLE 1: TOTAL POPULATION, AGRICULTURAL & VEGETABLE PLANTED AREA, AND VEGETABLE AREA PER CAPITA IN CHINA FOR EACH PROVINCE (1986)

	Total population (10,000)	Total planted area (1000 ha)	Total area planted vegetables (1000 ha)	Vegetable area per capita (ha/cap)
Total	105,397	144,200	5,304	.05
(Province)				
Beijing	975	605	58	.06
Tianjin	819	582	44	.05
Hebei	5,617	8,773	285	.05
Shanxi	2,655	3,952	112	.04
Mongolia	2,029	4,556	67	.03
Liaoning	3,726	3,664	231	.06
Jilin	2,315	4,037	161	.07
Heilongjiang	3,332	8,463	251	.08
Shanghai	1,232	679	71	.06
Jiangsu	6,270	8,514	312	.05
Zhejiang	4,070	4,362	199	.05
Anhui	5,217	8,163	180	.03
Fujian	2,749	2,401	174	.06
Jiangxi	3,509	5,439	211	.06
Shandong	7,776	11,043	348	.04
Henan	7,808	11,820	334	.04
Hubei	4,989	7,374	309	.06
Hunan	5,696	7,537	306	.05
Guangdong	6,346	6,111	397	.06
Guangxi	3,946	4,548	178	.05
Sichuan	10,320	11,853	526	.05
Guizhou	3,008	3,134	139	.05
Yunnan	3,456	4,024	126	.04
Tibet	203	211	8	.04
Shaanxi	3,043	4,678	134	.04
Gansu	2,071	3,502	60	.03
Ginghai	413	508	5	.01
Ningxia	424	824	14	.03
Xinjiang	1,384	2,850	64	.05

Source: China Agriculture Yearbook, 1987.

TABLE 2: LIVING EXPENDITURES, EXPENDITURES ON FOOD AND VEGETABLE CONSUMPTION IN CHINA, PER PROVINCE (1986)

	Total living expenditures (RMB)	Expenditures on food per capita (RMB)	As % of total living (%)	Vegetable consumption per capita (KG)
Total	357	201	56	134
(Providence)				
Beijing	644	292	45	184
Tianjin	480	336	49	106
Hebei	333	162	49	128
Shanxi	287	157	55	94
Mongolia	307	186	60	124
Liaoning	434	221	51	179
Jilin	389	215	55	216
Heilongjiang	338	191	56	186
Shanghai	896	406	45	113
Jiangsu	499	247	49	123
Zhejiang	561	282	50	130
Anhui	340	197	58	104
Fujian	394	237	60	123
Jiangxi	341	200	59	174
Shandong	365	182	50	130
Henan	292	160	55	75
Hubei	374	217	58	220
Hunan	386	229	59	160
Guangdong	454	267	59	125
Guangxi	284	176	62	130
Sichuan	311	195	63	158
Guizhou	272	191	70	158
Yunnan	305	205	67	153
Tibet	257	180	70	16
Shaanxi	263	147	56	69
Gansu	233	138	59	45
Qinghai	314	193	62	49
Ningxia	301	172	57	94
Xinjiang	317	180	57	111

Source: China Agriculture Yearbook 1987.

TABLE 3: SEVERAL PRINCIPAL VEGETABLES, ESTIMATED PRODUCTION AREA AND OUTPUT IN BEIJING (1985).

Principal Crops	Production area (ha)	Output (T)	Average yields (kg/ha)
1. Chinese cabbage (for storage)	4,477	335,130	74,855
2. Chinese cabbage	553	30,280	54,755
3. Tomato	2,363	104,350	44,159
4. Cucumber	2,321	78,260	33,718
5. Cabbage	1,187	42,000	35,383
6. Celery	942	39,635	42,075
7. Snap bean	2,535	38,295	15,106
8. Eggplant	1,075	33,440	31,106
9. Radish	953	32,055	33,635
10. Cauliflower	1,154	23,815	20,636
11. Stem lettuce	521	16,980	32,591
12. Sweet pepper	619	15,620	25,234
13. Others	2,532	----	----
Total	21,232	1,508,995	71,000

Source: BVRC, Beijing, 1986.

TABLE 4: SHARES OF VEGETABLE PRODUCTION COSTS FOR TROPICAL SOUTH CHINA, 1987 (RMB/HA)

Activity/Item	Share (%)
Non Labor Costs:	
Seed	6.4
Fertilizer	48.6
Pesticides	8.6
Animal force	3.7
Irrigation	0.9
Depreciation: Machines	1.2
Implements	2.4
Marketing costs	19.5
Subtotal:	100.00
Labor Costs:	
Land preparation	13.7
Sowing/transplanting	6.3
Fertilizing	6.7
Irrigation	5.7
Pesticides fumigation	15.7
Harvesting	17.5
Residue composting	3.0
Marketing	32.7
Subtotal:	100.00

Source: Tau and Siao, 1988.

TABLE 5: BENEFIT/COSTS OF VEGETABLE PRODUCTION OF 6-7 CROPS IN SOUTH CHINA, 1987

Activity/Item	Benefit/cost (RMB/HA)	Share (%)
Input costs:	5,220	30
Labor costs:	12,000	70
Total production costs:	17,220	100
Total sales revenues:	55,350	
Total net income:	38,130	
or for Average Farm:	4,321	
Return to costs:	3.2	

Source: Tan and Siao, 1988.

TABLE 6: RETAIL PRICES FOR SELECTED VEGETABLES. BEIJING, OCTOBER 1989

Vegetable	Price (US$/KG)
Chinese Cabbage	.08
Cauliflower	.24
Snap Beans	.27
Tomatoes	.27
Cucumber	.37
Yard-long Beans	.54

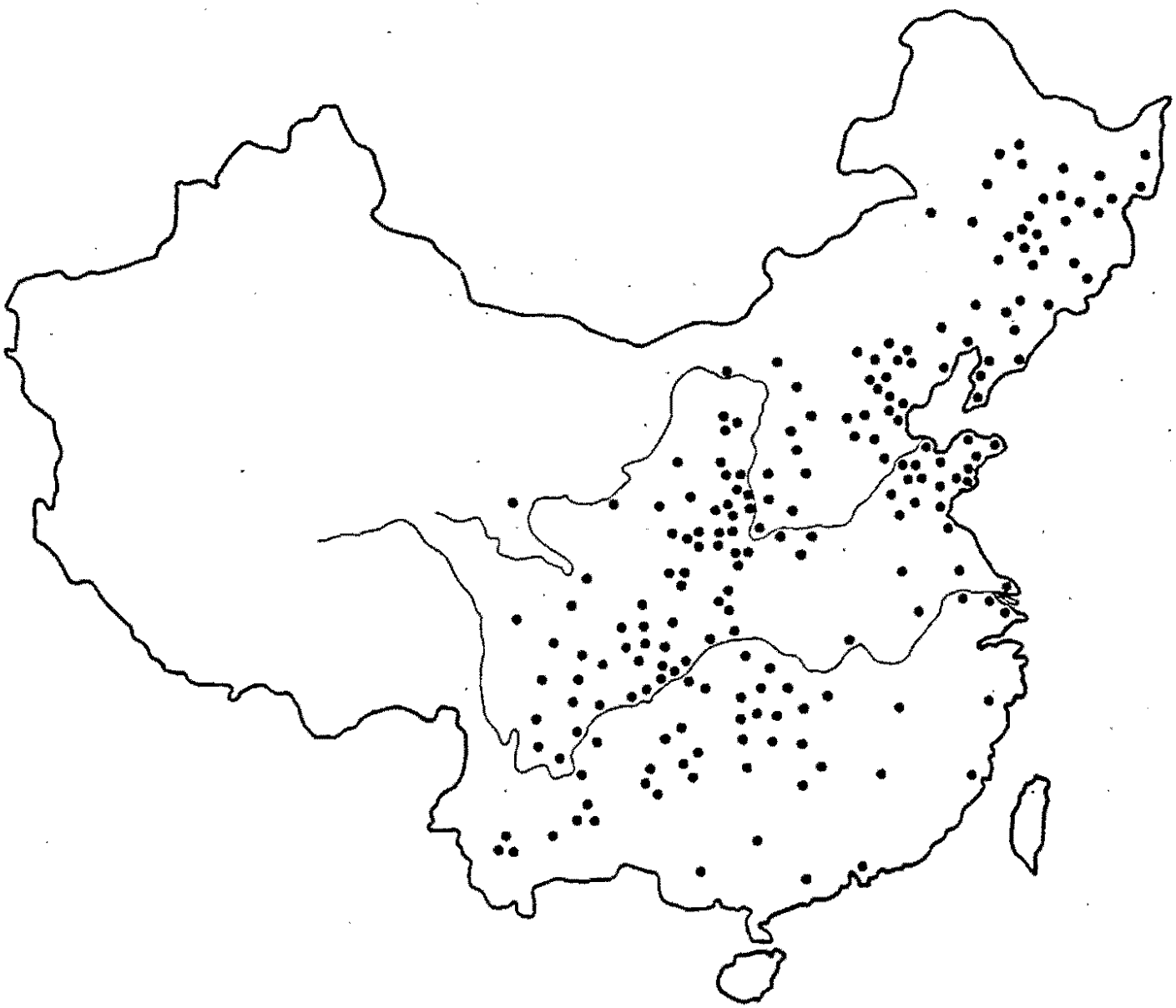
Source: Internal data, Snap Bean Project, CIAT, 1988.

TABLE 7: PRINCIPAL VEGETABLES CONSUMPTION ESTIMATES FOR CHINA, 1988

Vegetables	Share of Total Consumption (%)
Chinese Cabbage	52.0
Cabbage	9.0
Tomato	6.0
Radish	5.5
Cucumber	5.0
Eggplant	5.0
Snap Beans	3.0
Yard-long Beans	2.0
Celery	3.5
Sweet Pepper	3.0
Others	4.0

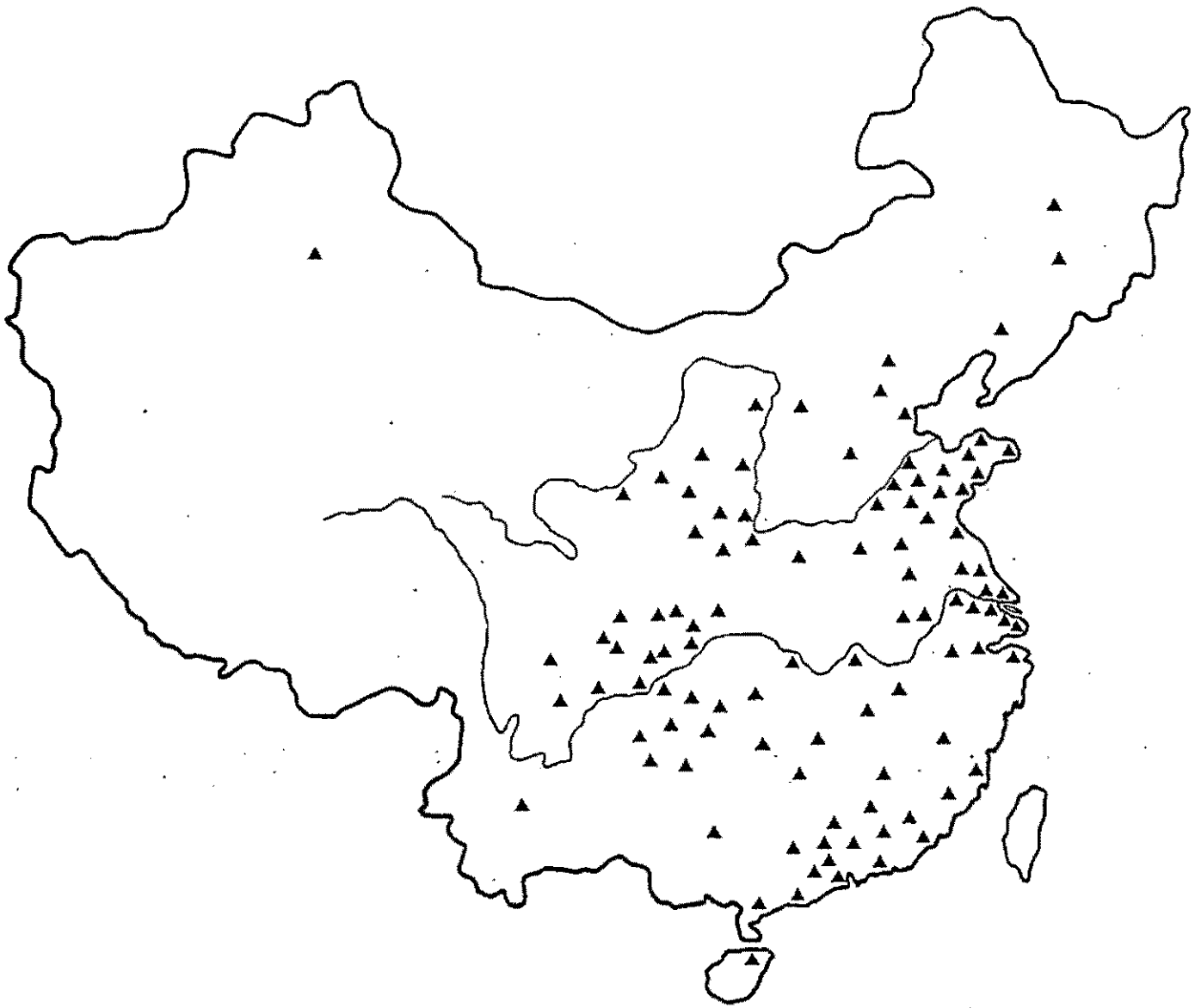
Source: FAO, 1988; BVRC, 1986; Chinese Agriculture Yearbook, 1987.

MAP 1: DISTRIBUTION OF SNAP BEANS IN CHINA



SOURCE: LI, 1989

MAP 2: DISTRIBUTION OF YARDLONG BEANS IN CHINA



SOURCE: LI, 1989