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VEGETABLES IN PANAMA'S DEVELOPMENT PROGRAM
AN ASSESSMENT AND RECOMMENDATIONS

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February 1, 1973

SUMMARY

Observations

Vegetable production plays a key role in the agricultural economy of Panama. Vegetable growers are market oriented. They use purchased inputs and provide employment in the country and in the industries which provide the inputs and distribute the produce. The eight fresh vegetables considered in this report, potatoes, tomatoes, onions, peppers, cabbage, lettuce, carrots, and beets, account for about five percent of the value of food produced in Panama.

Actual and recommended production packages were studied for potatoes, tomatoes and onions. The cost estimate worked out by Chen and by Fong are reliable and useful for planning and projection purposes. The high cost for production as all cases results not from excessive inputs of supplies and labor but from relatively low yields.

Low yields can be accounted for. Improvements can and will come but not without effort, investment, and patience. New varieties of potatoes, tomatoes and onions must be selected and in some cases bred to meet the soil and climatic conditions found in Panama. While the effects of some diseases and insects can be minimized through the use of resistent or tolerant varieties, better field practice, particularly better coverage of plants when spraying is indicated. Rotation of crops is badly needed. Soil conservation practices must become a normal part of farm practice if there is to be any hope of sustaining and improving yields.

Marketing and market information is the key to the most immediate possible gains. While much research is needed, many well known practices and services can be installed as soon as they can be financed. The Panamanian farmer has shown himself to be very responsive to opportunities for better returns on his investment and labor. Policies must recognize this and not assume that because a farmer lives in the country in a traditional manner his planting and production decisions are guided only by tradition.

The vegetable grower is seldom the marginal farmer, although he may farm a relatively small area. Management of vegetables is difficult and they are not good crops to use to bring the

subsistence farmer into the modern world. One exception to this generalization is when he can be induced to grow a single crop under contract and the contractor supplies the inputs, continuous technical advice and provides a guaranteed market for the product as long as the farmer follows the directions given him.

Recommendations

First priority should be given to increasing the efficiency of marketing system for vegetables. The improved market news service based on multiple check points should be activated as soon as possible. Forecasting of future demand should be a regular part of this service and farmers should be encouraged to plan production together in light of the forecasts. The physical facilities for marketing, especially wholesale marketing should be improved. Establishing a second whole sale and retail market between the developed part of Panama City and the Tocumen airport should be studied immediately and construction should move forward without delay if a feasibility study justifies the recommendation.

In production technology, first attention should be given to controlling disease and field losses. For the near term, this can be accomplished by improved methods of application of pesticides and better advice on timing of application of fungicides and

insecticides.

The research work at the University with grafted tomato plants should be encouraged. More extended variety trials are required for potatoes, tomatoes and onions. These must be at three levels, initial screening, replicated field trials in production areas, and test demonstration plots in farmers' fields.

As new varieties with satisfactory disease resistence and fruit quality are identified, the fertilizer recommendations should be tested and modified to improve its efficiency.

A formal link should be sought between the Ministry of Agriculture and the Facultad de Agronomía. One form which this might take is for the Ministry to contribute to the support of the fundamental studies in plant breeding, plant pathology, entomology and soil science. In return the professors at the university could supply advanced lines of plant material and new techniques and assist in planning field trials incorporating the most promising combinations. They could also identify and work on problems which Ministry specialists have discovered in the field but for which there is no immediate solution. A partnership which does not require loss of autonomy is in the interest of both the Ministry of Agriculture and the University but most of all in the interest of Panama and her citizens.

For the longer range, research is needed in two areas. One is breeding of crops specifically for Panama. This is a highly critical undertaking but not one which can be expected to yield immediate returns. The second is careful study of the technical aspects of produce marketing with the object of finding the most satisfactory compromise between additional operating cost and product loss. This should have some immediate return but the greatest value can be expected later.

There are some long range operational activities which are required. First among these is a soil conservation program. Others include additional access roads into new areas and additional services such a collecting stations for produce in the production areas.

Field ~~Tests~~ TESTS

Vegetable production is important in the Central Provinces and can play a key role in stimulating agriculture in the region. While most of the field test program recently discussed is aimed at the small holder producing grains at or near the subsistence level perhaps ten percent of the farmers enrolled in a pilot scheme could be either onion or tomato growers. This would be a very good way to get an extensive field evaluation of the grafted tomato with its resistence to bacterial wilt. It is already late to consider an onion program for this year but a beginning could be made with corn in the wet season to be followed by onions next December or January.

Whatever programs are recommended in production or marketing, existing facilities and services should be used. All fertilizer recommendations on cooperative experiments or demonstration plots should be based on soil tests. Accurate identification of diseases and insects should be made by Ministry or University specialists. The appearance of a pest should be noted and reported to all cooperators as soon as possible.

No farmer should be asked to bear the risk of an untried practice or unknown variety but he should pay the cost out of earnings, if the net return is better than he could expect following traditional practices. No inputs which are normally bought should be given free. No subsidies should be given to cooperators unless they are available to all farmers or unless they are reduced over an agreed period until the farmer is paying the full cost. While labor displacing machinery should not be introduced indiscriminately, more efficient use must be made of human labor so that men can earn a living wage. One of the major tasks is to develop or introduce machines which reduce peak seasonal demands for labor.

VEGETABLES IN PANAMA'S DEVELOPMENT PROGRAM
AN ASSESSMENT OF CURRENT STATUS AND RECOMMENDATIONS

Although no longer dominant, agriculture is still a major factor in the Panamanian economy accounting for 18 percent of the gross domestic product in 1970. Domestically grains dominate agriculture while bananas, shrimp, beef, and fish products are the key items for export. Panama produces over 80 percent of the food consumed in the country, see Table 1. Major imports include fish, meat and dairy products, wheat and fruits of temperate origin.

Vegetable and plantains, which are used as a vegetable although they don't belong in the category technically, make up 8-9 percent of the value of food consumed in the country and between 10 and 12 percent of the food produced locally. Their annual value ranges around B/10,000,000, Tables 2 and 3. The use of such a broad category is a deceptive simplification. Taking the typical vegetable crops and potatoes there are eight principal crops, whose annual value is roughly half the total. The potato alternatives, name, otoe, and plantain make up the other half. Even within the eight there is a variation in appropriate technology depending of end use, season and location of planting.

This discussion will include potatoes, tomatoes, onions, peppers, cabbage, lettuce, carrots and beets, a B/5,000,000 "industry", but detailed comments on the production technology will be limited to potatoes, tomatoes, and onions. Although marketing will be considered in other papers, it is so critical in determining the level of management possible in production that I will comment on marketing at some length. Although financing can be equally critical there was no time to inquire into it. This is also being covered in another section by specialists in the field.

General Observations on the Industry

The importance of these vegetable crops cannot be judged from the land which is committed to them. Only one to two percent of the cultivated land in the country is planted to vegetables in a given year. Table 4 gives an estimate of the land devoted to the eight selected crops since 1965, 1,639 hectares, and the actual plantings in 1971, 2,073 hectares. Data are from a report by Chen, except for industrial tomatoes which were estimated from other data. The relative importance of crops has not changed very much over the years but the area devoted to each has varied widely from year to year. This can be seen more clearly in Table 5, which gives area devoted to each crop, production and average yield for 1965 and each year since 1968.

The wide fluctuations can be attributed to many causes. Among those reported were unseasonable weather, poor supply of seed or late arrival, poor market the previous year, and shortage of labor at critical periods such as transplanting time. Fong called attention to the variation within years and demonstrated that with those crops such as tomatoes, cabbage and lettuce, which are not strictly seasonal, the price at harvest the previous year determined planting schedules. Farmers planned deliberately to produce for times of scarcity and good price but lacking knowledge of the current plantings oversupplied the market and broke the price in the wholesale market. Retail prices tend to be much less variable according to Fong and low prices in the wholesale market were not necessarily reflected in low consumer prices.

Considering the trend in production over the years, there was a considerable drop in area planted between 1965 and 1968. This fall-off was made up in 1970 and 1971. The total plantings when reported for 1972 promise to be near an all time high. The yields per hectare also show wide swings from year to year, but in general have shown a market improvement over those in 1965. This is extremely important because it costs almost the same to produce a good crop as a poor one. There was no suggestion from anyone that production of any of these vegetable crops was reaching the level of saturation. With such a small base, only potato plantings exceed 250 hectares. If we exclude

TABLE 1. AGRICULTURE AND PANAMA'S ECONOMY

(In millions of Balboas of 1960)

Budget Item	1966	1967	1968	1969	1970(R)	1971(P)
Gross Domestic Product	664.3	720.9	771.2	836.3	894.5	971.6
Agriculture & Fisheries	139.2	145.6	154.0	162.3	161.1	167.9
Ag & Fish Export	49.3	59.2	70.8	79.5	81.1	84.3
Net for Internal Use	89.9	86.4	83.2	82.8	80.0	83.6
Food Imports	15.8 (est.)	18.8	19.9	20.9	24.6	31.1
Apparent Consumption	105.7	105.2	103.1	103.7	104.6	114.7

Anonymous Panama en Cifras. Dirección de Estadística y Censo.

November 1971 and 1972.

TABLE 2. ESTIMATED WHOLESALE VALUE OF SELECTED HORTICULTURAL CROPS 1971

Crop	Value
Potatoes	B/ 1,840,752
Tomatoes	821,565
Onions	305,562
Green Peppers	125,040
Cabbage	574,464
Head Lettuce	675,000
Beets	175,014
Carrots	461,630
Total	B/ 4,861,033

TABLE 3. ESTIMATED VALUE OF POTATOES AND OTHER CROPS SERVING SIMILAR ROLE IN NATIONAL DIET. 1972

Crop	Production	Value
Potatoes	188,990 qq.	B/ 1,840,752
Name	215,606	1,541,583
Otoe	125,612	967,212
Yuca	558,895	1,609,508
Plantain	1,268,010	4,438,035

TABLE 4. TRENDS IN LAND USE FOR VEGETABLE CROPS AND REPORTED AREA IN 1971

Crop	Seven Year Pattern	1971
Potatoes	470 ha.	850 ha.
Tomatoes - fresh	59	63
processing	602 (est.)	338
Onions	135	187
Peppers - sweet	21	26
Cabbage	88	193
Lettuce	78	155
Beets	26	31
Carrots	160	210
Total	1,639 ha.	2,073 ha.

TABLE 5. LAND AREA PRODUCTION AND YIELD OF SELECTED HORTICULTURAL CROPS - 1965-1972

Crop Year	Area Planted	Production	Yield
Potatoes:			
1965	580 ha.	131,220 qq.	226 qq/ha.
1968	374	139,066	372
1969	206	68,750	334
1970	338	141,841	420
1971	850	255,666	300
1972	-	188,990	-
Tomatoes:			
1965	660	202,700	307
1968	39	35,282	904
1969	51	11,312	221
1970	64	20,454	320
1971	83	26,135	315
1972 (Est.)	-	39,000	-
Onions:			
1965	90	33,100	368
1968	122	59,520	488
1969	152	51,287	337
1970	126	48,602	386
1971	187	71,526	382
1972 (Prov.)	-	148,564	-
1965, 1971 & 1972 Annual Production - 1968, 1969 & 1970 Dry Season			
Green Peppers:			
1965	120	13,300	111
1968	-	-	-
1969	15	4,331	288
1970	22	9,741	443
1971	26	7,815	300
1972 (Prov.)	-	23,462	-

Table 5 -cont.-

Crop Year	Area Planted	Production	Yield
Cabbage:			
1965	210	40,600	193
1968	-	-	-
1969	28	11,693	418
1970	43	16,093	374
1971	193	71,000	372
1972 (Prov.)	--	58,540	-
Head Lettuce:			
1965	100	26,300	263
1968	-	-	-
1969	23	6,421	279
1970	35	9,866	282
1971	155	45,000	290
1972 (Prov.)	-	44,530	-
Carrots:			
1965	240	21,600	90
1968	-	-	-
1969	81	13,899	172
1970	109	21,447	197
1971	210	46,183	220
1972 (Prov.)	-	27,740	-
Beets:			
1965	-	-	-
1968	-	-	-
1969	13	1958	150
1970	33	5842	177
1971	31	14,274	460
1972	-	-	-

Chen G., A.M. Costos de Producción de Hortalizas en las Tierras Altas de Chiriqui y las Provincias Centrales. Oct. 1971.

Anon. Consumo de Productos Alimenticios. Datos Provisionales. MAG 1972.

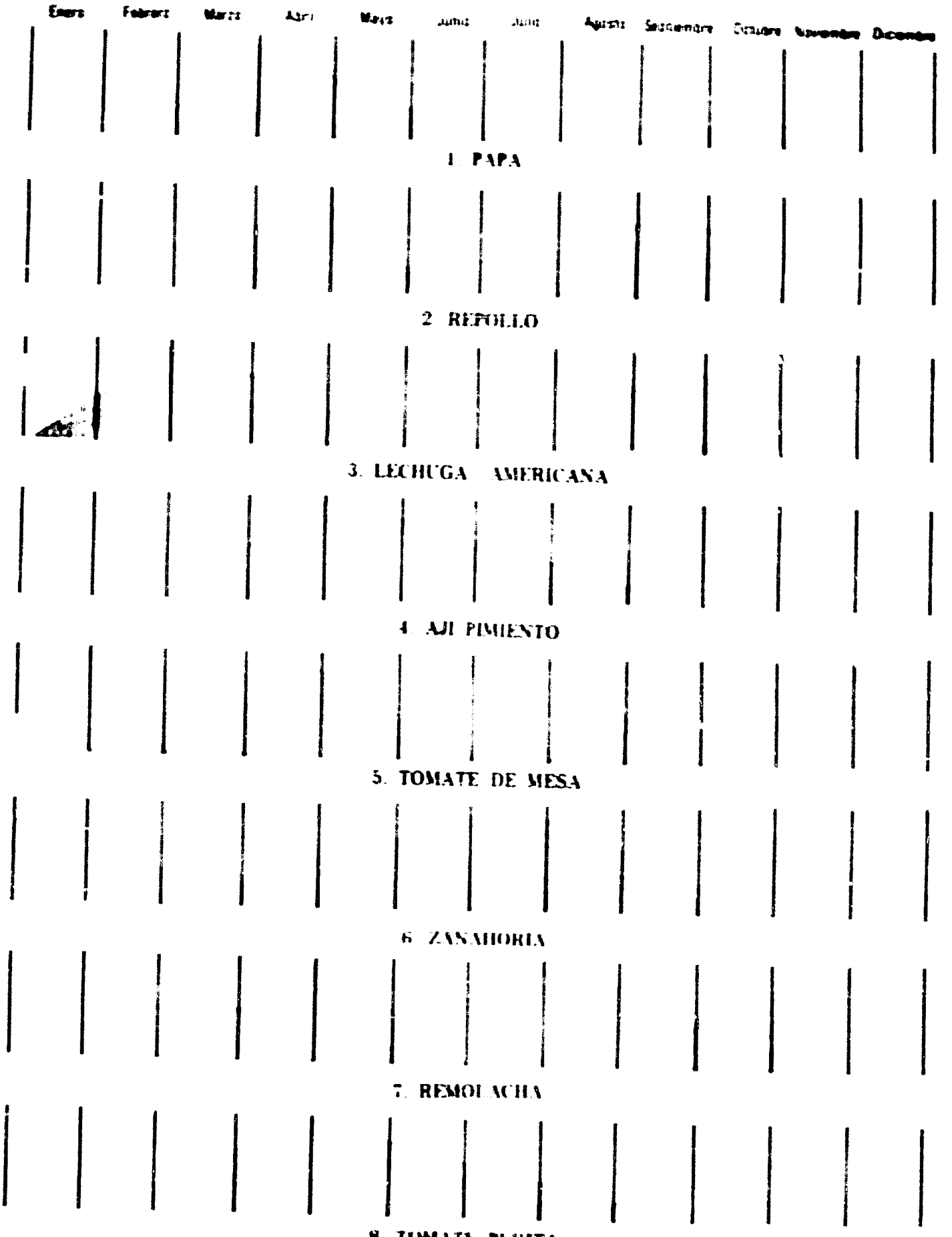
tomatoes produced under contract for canning and processing saturation is a very real danger. On the other hand seasonal surpluses are clearly recognized as a problem.

What of seasonality and to what extent is it practical or even possible to rationalize the supply of vegetables? Figure 1 shows the peak production periods for various crops. In almost all cases the peaks correspond to the maturity time of crops planted at the close of the rainy season and growing through the dry or summer season when diseases and insects can be most easily controlled. Even the logical substitutes for potatoes tend to reach maturity at the same time. Only yuca and carrots show a true "off-season" peaks. Other crops do have secondary peaks corresponding to the "winter" dry season. These are the natural times to produce the crops and good supplies during these periods should be expected and not considered unwise unless prices drop below a level which gives the farmers a reasonable return.

Two general approaches are being used to equalize the supply over the year. The first is to go against the natural cycle and plant in the off season. Fong calls attention to the success of this practice with cabbage, lettuce and tomatoes. The University has an unusualapproach to the production of "winter" tometoes, turning a well known botanical curiosity, into a remunerative commercial practice. They are grafting tomato plants onto wild root-stock. Other attempts to grow

MINISTERIO DE AGRICULTURA Y GANADERIA

PERIODOS DE MAYOR PRODUCCION DE HORTALIZAS EN PANAMA



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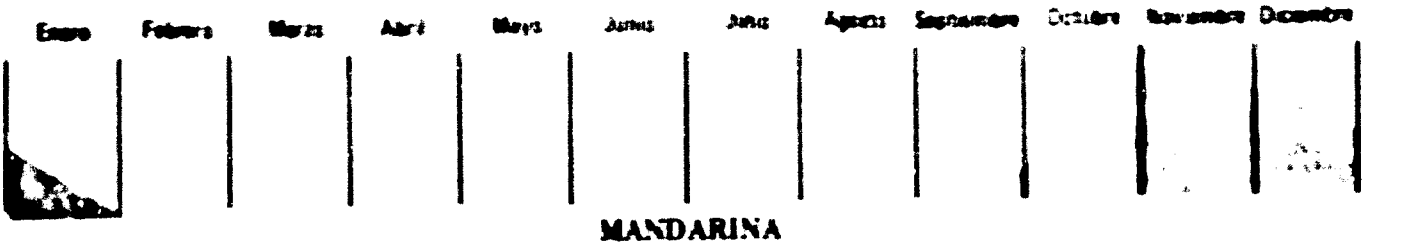

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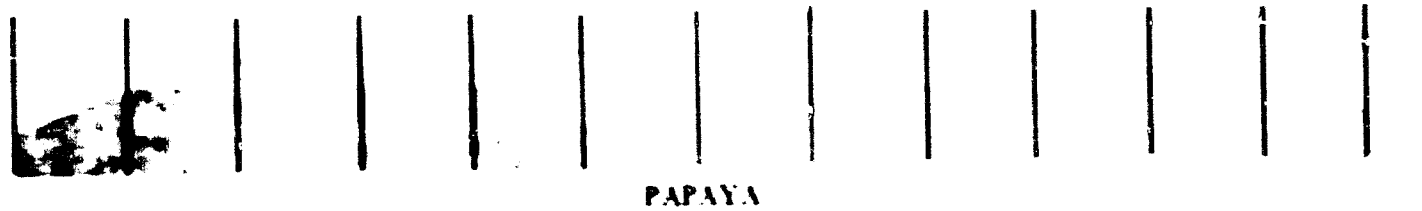

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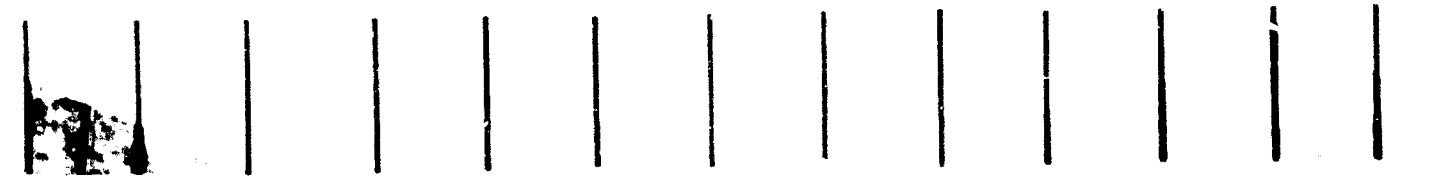

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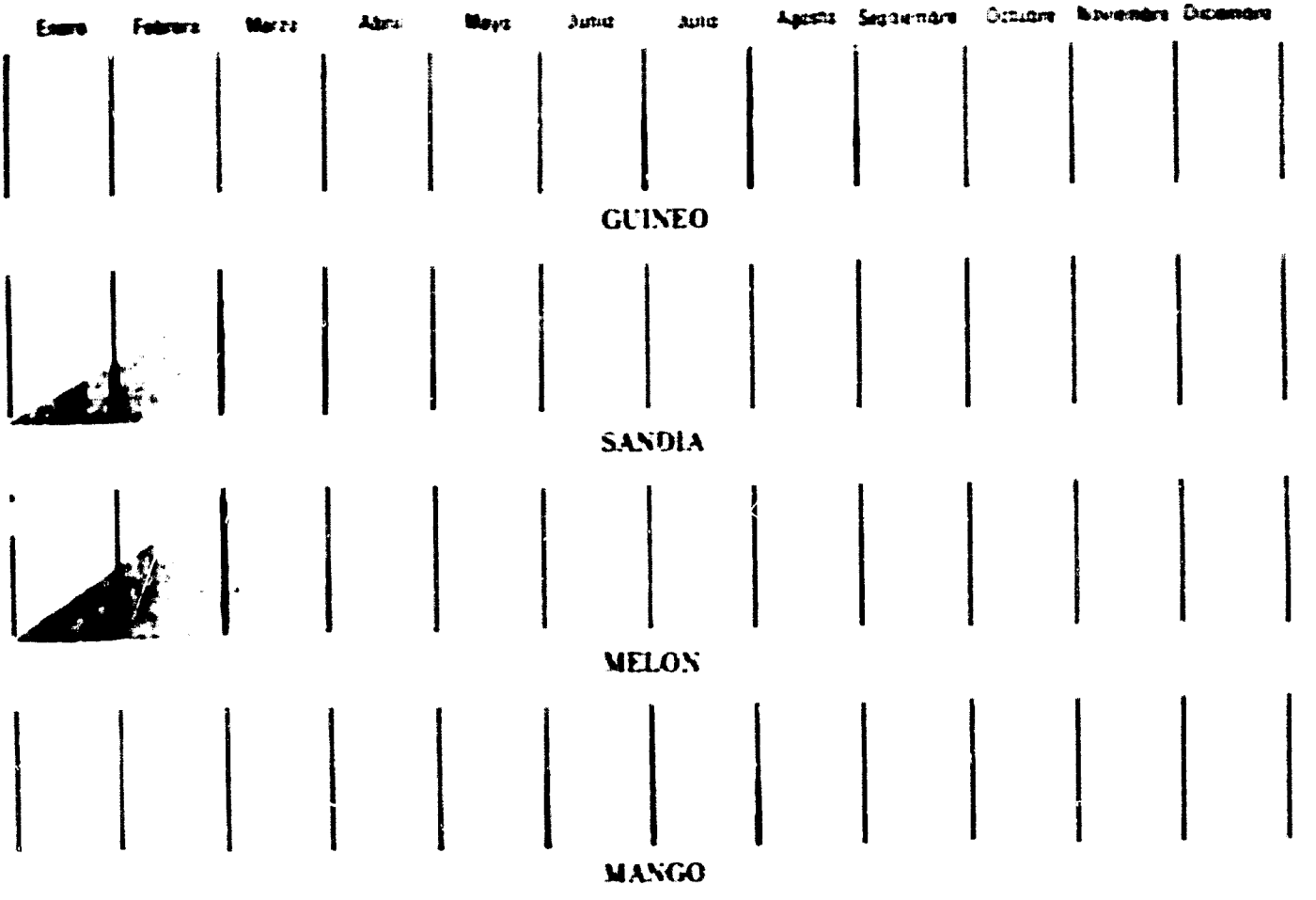

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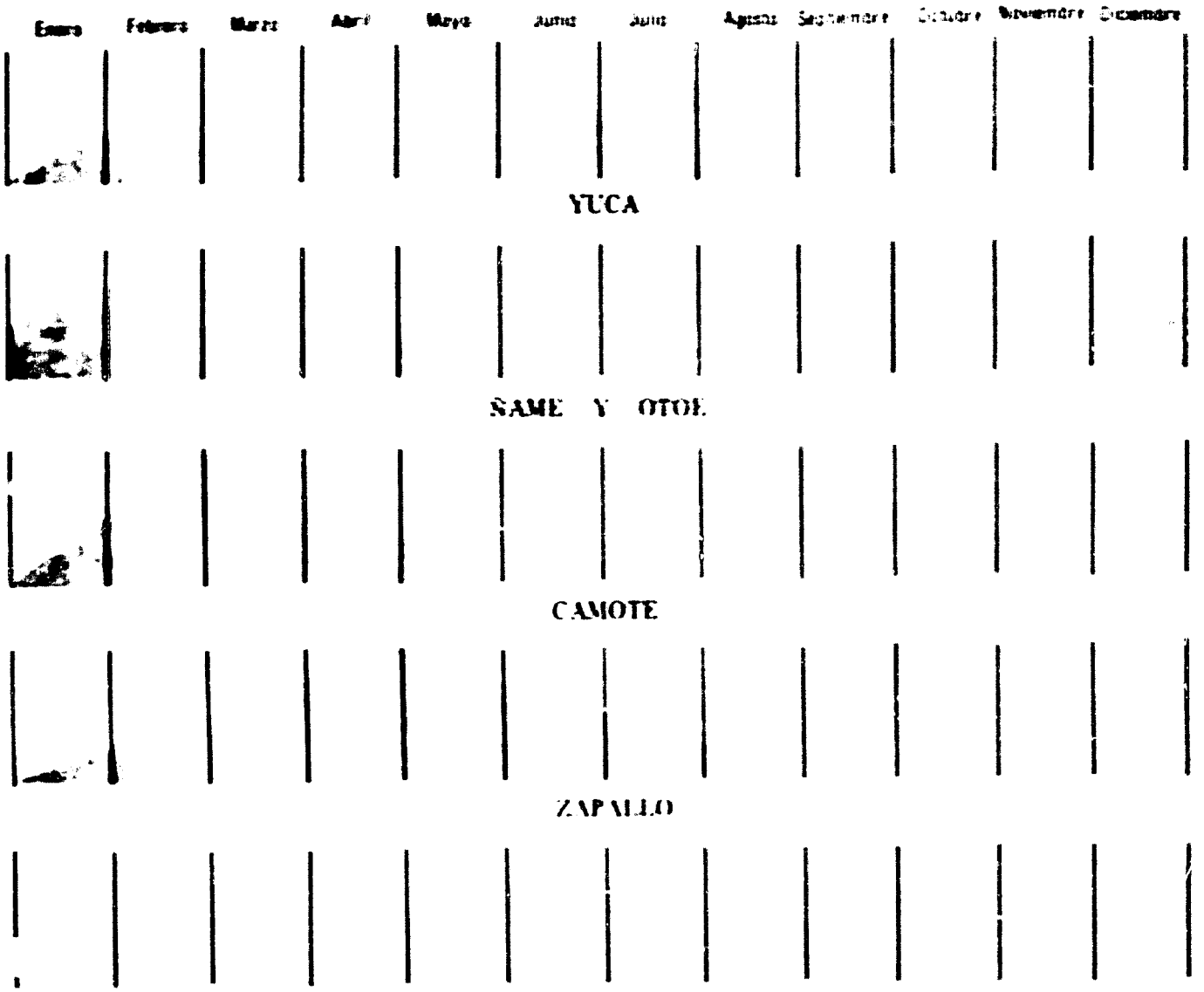

during the off season have been encouraged by the availability of new pesticides, including herbicides and selection of disease resistent varieties. The second approach is that employed from necessity in temperate climates, storage of production during the peak season and delivering from storage during the time when the crops is no longer being harvested. This is a successful practice with potatoes and onions. Processing tomatoes is an equivalent practice except that for practical purposes there is no limit in storage time. Further comments will be made on storage as individual crops are discussed.

Cost of production and likely gains are the real determinants of supply of fresh vegetables and potatoes. Production costs in Panama are relatively high. Examples worked out by Chen of the Instituto de Fomento Económico are shown in Table 6. These give a good idea of the risk which a farmer assumes when planting any of these crops. The potential gains appear very attractive but there are many restrictive considerations. The first is that the expected yield may not be realized. If yields are good the wholesale price is likely to be well below the annual average. For most crops, except industrial tomatoes, the average planting is below one hectare and often no more than 0.1 hectare. Even in the case of industrial tomatoes, in 1972, 450 farmers had an estimated 600 hectares planted. Their risk was mininized through

contract but their returns were correspondingly reduced.

Although the data in Table 6 serve to illustrate both the high cost and high value of the selected vegetable crops, they should not be considerable absolute. They were obtained from different sources . Relative by small biases in estimates can make large differences in the apparent earnings.

Some of the original data is troublesome and should be verified. For example, a yield of 400 quintales of peppers per hectare, exceeding that for tomatoes, seems extremely optimistic. A yield of 400 bushels of sacks weighing perhaps one third this amount seems more probable. Neither the potato nor onion prices or costs as, the case may be, take storage charges into account but this cost will have to be paid, presumably by the farmer. Both cabbage and lettuce will have high losses in harvesting, transport and marketing. It is very unlikely that the gross earnings will ever reach the calculated level. It does seem likely that the yields on tomatoes grown under contract for processing are better than the 400 qq. used to estimate costs. The calculated return is too low to encourage farmers to accept the risk of production, even for a guaranteed market.

The estimated costs of production as calculated by Chen are reasonable. The potential yields or quantity of saleable product and prices are highly speculative. These data do emphasize the

TABLE 6. PRODUCTION COSTS FOR SELECTED CROPS AND ESTIMATED RETURNS

	Crop				
	Potato	Tomato Processing	Tomato Fresh Market	Onions	Peppers
Production Cost B/Ha.	997.56	1167.25	1871.50	1626.40	1318.49
Yield qq/ha	300	400	300	350	400
Cost B/./qq	3.33	2.92	6.34	4.65	3.30
Estimated value B/./qq	7.00	3.00	15.00	9.00	16.00
Gross Return B/./ha.	2100.00	1200.00	4500.00	3150.00	6400.00
Net Return B/./ha	1102.44	32.75	2628.50	1523.60	5081.51

	Cabbage	Lettuce	Carrots	Beets
Production Cost B/./ha	932.49	742.95	599.03	645.04
Yield qq/ha.	600	300	300	300
Cost B/./ha.	1.55	2.48	2.00	2.15
Estimated Value B/./ha.	6.00	13.00	10.00	11.00
Gross Return B/./ha.	3600.00	3900.00	3000.00	3300.00
Net Return B/./ha.	2667.51	3157.05	2400.97	2654.96

Chen G., A.M. Costos de Producción de Hortalizas en las Tierras Altas de Chiriquí y en las Provincias Centrales. Oct. 1971

Anonymous. Precios Pagados por Mayoristas a los Agricultores y Traficantes en la Ciudad de Panamá por Mes. Años 1967-1971. M.A.G. Dirección General de Mercadeo. Feb. 1972.

relative attractiveness of vegetable farming and its economic importance despite its limited size.

The high returns raise the question of why so few farmers grow vegetables. The first is that vegetables of commercially acceptable quality are difficult to grow. The second is that a relatively large capital investment is required. Being labor intensive, hired labor is required on even small farms and the laborers must be paid in cash when the task is completed. Purchased inputs such as seed, fertilizer, pesticides and fuel must be paid for. The risk of failure is high and only those who can, and will accept the risk, go into vegetable farming.

There is more than enough land available to meet the needs of vegetable farmers until well beyond the year 2000, if the land now in use is properly cared for. The most precious land is the mountain land where the climate is more suited to many of the vegetables rather than in the low lying areas of the country. This is also the scarcest land and, more importantly, the land most likely to be damaged by erosion. The lack of good soil conservation practices in the Volcan-Boquete region is a genuine cause for concern. The probability of damage is increasing as more and more land is being cleared. The very wealth of this soil is hiding most of the damage which is being done. The load of earth on the streams was dramatically described by a number of persons with whom we talked. More tragic evidence is the recent flood which hit Boquete, washing away houses and

stripping the bank of the river of productive soil, leaving a path paved with boulders.

New lands will play an important part in the vegetable industry over the next few years. The paving of the road west of California, toward Santa Clara and the Costa Rican border, is opening that region to the production of bulky crops. Some of those who will start farming in the new area have already been farming and will simply be looking for new and perhaps less expensive land. Others will be new comers to vegetable farming and may or may not find it to their liking. In any case the total supply of vegetables is almost certain to increase and may increase to the point where prices fall sharply and the farms with high costs will be driven out of production by the competition.

It seems unlikely that the two large undeveloped land areas of the country, Bocas del Toro or Darien will be significant factors in vegetable production. The high rainfall on the north side of the cordillera will make growing vegetables a marginal operation if not an impossible one. The lack of any examples of vegetable production is likely to delay vegetable production in Darien even at the higher altitudes.

Production of Potatoes, Tomatoes and Onions:

Potatoes, tomatoes and onions are among the most important vegetable crops grown in Panama. Their production is being encouraged through import limitations and price control. For all of the encouragement, the active demand for these three

vegetables is not yet being met by the Panamanian farmer. The uncertainties and the risk which derive from them are responsible in part. Another reason is simply that local, that is national production has not always had the priority it now receives. Formerly all three vegetables were imported in direct competition with local farmers. In view of their high production costs it was impossible for the Panamanian farmers to meet the price of the imported produce. Additionally the local farmer did not have the packing house facilities to grade and pack in as uniform and attractive manner as the producers abroad.

Potatoes

Starting with potatoes, the most important crop for direct sale to the consumer, why are the costsso high? According to Chen's calculations, it costs B/3.32 to produce one quintal of potatoes. Roughly two thirds of this was for the purchase of necessary inputs. The first of these, seed, might be considered optional. Local seed could be used. With the necessary treatment, storage cost and shrinkage,its cost would be about two thirds that of imported seed. The saving would be equivalent to less than eight quintals of harvested crop. Considering virus infection in the local seed alone, imported seed can be expected to produce a minimum of 25 quintales of additional yield. This is a return of three for one is a good standard for cash return on investment.

The varieties mentioned in the field were [illegible]stly well known varieties 20 years ago. In addition almost al[illegible]re bred for the U. S. or Europe and not for the [illegible]ics. We [illegible] no variety trials in

progress nor did we find much interest in the relation between variety and yield. Market acceptance and disease resistance were mentioned but the trade-off's in terms of production against selling price were not discussed. Variety is also important for the marketing schedule. High starch varieties normally store better and longer than those with lower starch and more soluble sugars. White and yellow flesh varieties normally store better than red skin varieties and usually a russet skinned variety will store better than one with a smooth skin. The russet varieties are not well received in some markets but from what I have seen they should be competitive in Panama.

After seed fertilizer is the next most expensive purchased input. What savings might be possible? Applying fertilizer according to soil analysis should make it possible to use the money spent on fertilizer more efficiently. The current recommendation seems very sure to produce good yields but seems likely to be too costly, especially on land which has been fertilized for a period of years.

The cost of pesticide may even be underestimated. Perhaps one of the reasons for relatively low yield is a problem of insect and disease control. This is a factor almost impossible to assess without working with the crop through several seasons.

Labor is a very significant factor in the cost of production of potatoes. The steep slopes in most of the region around Cerro Punta and Boquete limit the possibilities of

efficient field layout and the use of field machinery. A simple seeder and potato digger for use at harvest could reduce labor needs at these two critical seasons substantially and even out the need for hired labor. They were said to be available but none were seen.

The most costly operation from the point of view of labor is spraying. This is not concentrated within a short period but must be done at least weekly throughout the growing season. It is not likely that much saving will be possible in this operation except in relatively flat fields where tractor mounted spray rigs can be used.

The efficiency of coverage rather than labor cost is the more critical factor from my observations. The only spraying we saw was being done with gun type sprayers. The pressure was sufficiently high and good agitation of the leaves was obtained. It seems impossible, however, that really through coverage could be obtained as the plants matured. Unless this is accomplished, all of the expense of spraying is incurred but infection occurs anyhow, although it would be less severe and cause less reduction in yield than in unsprayed fields. Spraying with multiple nozzles, with the lower ones directed upward and opposing nozzles not quite directed at each other will provide coverage of both tops and bottoms of the leaves, the petioles and the stems to the ground. This thorough coverage is especially

important for control of late blight.

Although some growers were harvesting, we did not see the operation. Potatoes delivered to the cooperative's bodega were quite immature and covered with wet soil. Washing, drying, and sorting would have improved both their appearance and the keeping quality. Since there were no facilities for drying, it was probably better to leave the potatoes unwashed.

We visited the experimental potato bodega in Cerro Punta but could not find anyone with a key to let us in. The basic idea is very similar to one visited in the Guatemalan highlands and this one should work equally well,, As we understood, the plans are to store the potatoes in sacks. During the test period it would be worthwhile to compare storage in slatted crates with storage in sacks. Sorting will be necessary before shipping from storage so that using crates will not involve extra handling.

I did not understand the financial arrangements covering the storage or the arrangements for determining the return to each grower.

Through the cooperative efforts of the Junta Nacional de Mercadeo de Papas, wholesale prices have been maintained at a reasonable level for the past year, B/7.00 per quintal. The retail price has been holding at the maximum, even during periods of depressed wholesale prices, so that the consumers have not suffered. Price stabilization has been accomplished in part by limiting daily offerings. The limits are enforced at the "garita"

at Risacua. No potatoes are allowed to pass unless covered by an authorization from the Junta. The unanswered question is whether receipts are pooled or whether the grower receives the price paid. If the latter and a uniform selling price is maintained, does the grower who digs early before the crop has fully matured and reached full weight receive some adjustment? Does the grower who stores potatoes taking the shrinkage and bearing the cost of his bodega received compensation for expense and loss? Who decides when potatoes are to be dug and sold or dug and stored? Since delay in sales also means delay in receiving payment for the crops, is there any commodity credit available to the grower while he is waiting for the crop to be sold? If there is credit, what interest is charged? Who pays the interest? What are the limits on the credit?

The production guide "El Cultivo de la Papa" by Eduardo Esquivel of the Ministerio de Agricultura y Ganadería, is a good, well written guide. One unfortunate typographical error shows the seed requirement as 11.4 to 15.9 tons of seed per acre rather than 1.14 to 1.59 . This should be corrected in later editions. The correct figure is used in the sample cost calculation. The importance given to control of seedborne disease is justified. I recommend that no home grown seed be used, even with all treatments, but that seed be secured which is certified to be essentially free of virus. It should be treated against scab and Rhizoctonia as well and come from an area known

to be free of the golden nematode.

More attention should be given to complete coverage of all aereal parts of the plant while spraying. A clearer distinction is needed between insect control and disease control. The author has made this distinction just not emphasized it sufficiently. Fungicides are used to prevent infection to the extent possible. Timing is dictated by weather conditions and existence of possible sources of infection. Insecticides must be used selectively and only to the extent that they are absolutely necessary. Regular, preventative, sprays with insecticides are not only unnecessarily costly, they can be very damaging to beneficial predator species and make effective control virtual impossible or prohitively expensive. One final caution on insecticides is that a period between the last use and harvest should be specified. Although I cannot pass judgement on the choice of fungicides, my own experience has been that continued use of zineb or manex would be preferable to changing to the fixed copper.

Tomatoes

Tomatoes are one of the most important crops produced in Panama and industrial tomatoes account for 90 percent of the production in most years, Table 7. This does not mean that tomatoes produced for the fresh market should be discounted.

Table 7. PRODUCTION OF TOMATOES FOR FRESH MARKET AND FOR PROCESSING

Year	Production	
	Fresh	Processing
1968	35,282 qq.	290,560 qq.
1969	11,312	307,480
1970	20,454	231,220
1971	26,125	135,000 (est.)
1972 (Provisional)	39,000	270,000 "

Combined from various sources: Panamá en Cifras 1971; Chen G., A. A. Instituto de Fomento Económico. Memo. Ruben A. Berrios to M. S. Novins. Jan. 23, 1972

solanum diversifolium.

All three methods of approach to this fundamental disease problems are worth following. The grafting technique offers the most immediate solution and perhaps the only solution for a rainly season crop which takes advantage of the seasonally high prices. For midrange, it seems likely that superior varieties produced elsewhere may prove satisfactory and annual variety screening and adaption trials are needed. Finally, the local breeder even with limited resources can probably reduce the best variety for Panama given sufficient time. With a crop whose annual value at wholesale is approaching and could easily exceed B/1,000,000 much more research investment, than I have been able to discover, is amply justified.

Production costs for tomatoes are higher than for most other crops. Shifting to new land and new areas to avoid the bacterial wilt has added to the cost, although this is difficult to quantify. Seed is a relatively minor item, as far as cost is concerned. or flat planting enough plants for a hectare can be grown for B/25. Including seed, sterilization of seedbed and care till transplanting. Chen uses a somewhat higher estimate but is very conservative in his estimate of usable plants from the seedbed. On the other hand if grafted plants are to be tried, the estimated cost is B/300. for flat planting and roughly double that for staked tomatoes.

Applying fertilizer according to soil test could save a small amount, or better, give more yield. Without good wilt resistent varieties fertilizer trials are difficult to run, and a good guess may be about as reasonable a ground for selecting rates of application as any. General experience is likely to be more reliable than a few isolated trials.

The spray schedule used for cost calculation is probably too short or assumes that spraying may be spaced at wider intervals than seems advisable without more data than I have seen. Both the MAG and the University recommend herbicides to reduce labor and eliminate disease and insect harboring plants. This seems a preferable means to reduce labor cost. Where soil borned diseases are a problem, cultivation can cause as much harm as it prevents. Care would certainly be needed in hilling to avoid damage to roots and plants. The plastic mulch or sawdust being used by the University should be tried on a commercial scale to determine whether it will or will not be more productive than traditional cultivating and hoeing.

There is little opportunity to reduce cost by reducing labor inputs. Irrigation and spraying are expensive operations. Row irrigation is preferable for both industrial and table tomatoes, since it reduces the problems with leaf diseases. Spraying by machine would be more efficient using

somewhat less labor. It would increase fixed costs and and interest because larger more expensive pumps and sprayers would be needed. The change cannot be justified as a saving in cost, but should definitely be considered as a way to get better coverage and disease control.

The principal difference in cost between industrial and fresh consumption tomatoes is the added cost of staking. The stakes were estimated to cost B/0.01 in the 1971 study by the University. A price of B/0.015 or B/15.00 per 1,000 was quoted to us during our trip to Boquete. There is also the cost of the additional labor to set stakes, tie plants and prune excess branches. Considering the yields reported, the value of staking the tomatoes even for table use seems highly questionable. The use of a mulch to prevent contact with the soil which would also control weeds and reduce, or eliminate the need for hilling, appears to be a better investment.

Tomatoes for table use are allowed to mature more in Panama than in the U.S. This is a reasonable practice since they are only one day from the point of retail sale. No refrigerated transport was seen. There was no cooling of the fruit to reduce field heat or refrigerated storage in the market.

The production guide prepared for MAG by Dr. Rolando Lasso and Ing. Germán de León "Producción de Tomate Industrial" is both explicit and comprehensive. Although the production costs are somewhat lower than those calculated

by Chen, they are of the same order. None of the costs are inordinately high nor is the labor input excessive for the crop and general level of technology required. High unit costs are the result of the relatively low yields. If the recommended practices were fully carried out in a timely manner, it is likely that yields would be substantially better than those observed. The unresolved problem of bacterial wilt and its control is the next major hurdle which must be passed before a new level of commercial yields can be expected.

Lasso and de Leon make the point that rotation is necessary for successful tomato production because of the buildup of soil borne diseases. This is a highly desirable practice and should be followed where possible. A large part of the pasture land seen during our field trip would be useful for vegetablesin general, and tomatoes in particular. Using a portion of this land one year in seven could provide a measure of weed control, build the fertility and allow for reseeding with the latest improved pasture grasses. The return from the land whether rented or used by the owner would be greater than from the pasture. The combination of rice or corn as the wet season or winter crop and onions or melons as the summer crop would bit the needs of the small landholder better.

Weed control is extremely important and control of weeds which are alternate hosts to tomato viruses is doubly important.

Peppers, eggplant and especially potatoes should not be planted near tomato fields. Corn, onions, cabbage, melons, watermelons squashes may all be used. If related species are to be planted one of these crops should be planted to form a border. Particular care is needed to remove perennial solanaceas plants such as the "friega-plato" from the uncultivated land or field nearby. Much of the advantage of rotation can be lost if these border effects are ignored. Machinery and even hand tools and shoes can carry disease. The recommendation that budding knives be washed with three percent trisodium phosphate should be followed when tools are moved from old fields to new ones. Special care should be used to remove clods or other large accumulations of soil which can be easily dislodged. Cross traffic should be avoided.

The Ministry publication recommends that tomatoes for processing be delivered to the factory within 24 hours of picking. This certainly should be the maximum allowable delay. Vines should dry thoroughly before picking is started. Once fruit is picked it should be moved into the shade if possible. No spoiled fruit should be put into the crates for delivery to the cannery or to the packing area. Fully mature fruit is needed for processing. Fully mature fruit for table use will not carry to distant market. All fruit destined for Panama City and Colon should have begun to turn red but little more.

Onions

Onions are an important vegetable in the Panamanian diet and one which is used regularly throughout the year. Until the construction of cold storage, supplies for the off season were imported. Often, we were told, imports continued after the local harvest commenced and were directly competitive. The abrupt increase in plantings in 1971 and 1972 is a direct reflection of the availability of storage and the opportunities which such storage creates.

In discussing varieties with growers and officials, it appeared that all those being planted in commercial quantity are varieties which have been known for a very long time and varieties which have proven useful in the tropics but which were originally developed for more temperate climates. The seed is imported and there were complaints that last year, presumable 1972, seed arrived late and delayed planting. Late planting combined with an early onset of the rains led to soft and immature bulbs at harvest. As a result there were very large losses in storage. As a measure to prevent damage to the extent possible, a drier has been installed in Chitré. Although we did not see the drier, we did see the cold storage unit and discuss its operations with the officers in charge.

There are many factors to be considered in selecting varieties. An urgent one for Panama is the selection of varieties specifically for storage and planning of deliveries to storage well before the onset of the rains. Some losses

are inevitable but very good opportunities are overlooked. Weather is not predictable four months in advance, but "insurance" can be obtained by planting according to a planned schedule and by increasing the number of varieties planted. Varieties should be selected to give a range of early and late maturity with thin and succulent "leaves" within the bulbs. Seed could be produced in Panama but it is unlikely that the volume would justify all of the facilities and trained personnel to assure superior quality.

As with other crops the fertilizer recommendations seem based on a wish for security rather than on a fundamental determination of soil needs. The one comment on soil tests was that the results came too late to be useful. This may have been the experience in the past, but using the service which now exists would seem to offer possibilities for better matching of soil and fertilizer. Analysis from the highland areas suggest that the current emphasis on high phosphate mixtures may not be needed, especially where potatoes or onions have been grown for five or more years. This could be especially important in the next few years when phosphate fertilizers will be in short supply and prices can be expected to be much higher than they have been in the past. The supply of high analysis formulas such as the 10-30-10 and 12-24-12 will be particularly tight.

The cost of production as worked out by Chen seems entirely reasonable. Land preparation costs and the labor requirements

are consistent with those for other crops. Seedbed preparation for growing plants to transplant into the field is costly but very efficient.

We inspected one Ministry seed-bed where plant were being produced for sale to local farmers. This seems a practical solution for farmers not ready to undertake to precautions required to produce disease free planting stock. The price for plants quoted, B/1.50 per 1,000 appeared to be sufficient to cover the cost and to be fair to the farmers. We did not find out whether requests for plants had to be placed before the beds were seeded or whether plants were simply sold on a first come first served basis. Some system of preplanning would seem to be necessary to avoid charges of favoritism, if demand should exceed the supply or of wastefulness if many too many plants were grown.

The process of transplanting the onions to the field appears to be the most wasteful of manpower in all of the vegetable productions we observed. The spacing is even closer than that used for hand transplanted rice. We watched one field being planted by an experienced and successful grower. He had two men working full time marking one hole at a time with a pointed stick. This seemed necessary because the bed was watered just prior to setting the plants. If it had been irrigated the previous day, a peg board which made 10 rows with

10 holes each could have been used. Ing. Felix Estrada, who accompanied us on this part of the trip, told us that he had used such a board very successfully.

A bit more elaborate system would be a transplanting cart. One of the difficulties for the boys setting plants was reaching across the bed. A simple cart with seats for two men driven by a lever and rachet could open the holes for transplanting, carry plants and starter solution for watering them in, and reduce transplanting time by half. This could be very useful since there is a very high demand for labor at transplanting time which is not equalled at any other time. A rough sketch of the cart with the drive and hole opening mechanism will be prepared in case some gadgeteer can be tempted to build one to try it.

Chen estimates that transplanting onions requires 150 man days per hectare. Before I saw the operation, I thought the estimate high. Since watching a successful grower manage the transplanting on a commercial farm, I am willing to admit that this is a good or even optimistic estimate of the labor actually used for transplanting.

Apparently the use of herbicides has become standard practice. This has reduced if not eliminated the labor required for weeding which used to be the most difficult and expensive operation in growing onions.

Fungicides and insecticides are absolutely necessary. It is likely that labor is used somewhat more efficiently in these operations than is indicated by Chen's calculations, but not enough to change the conclusions which might be drawn from the analysis.

Even in times of good markets, premature harvesting should be avoided. Planting of precocius varieties could help in this regard. Improved storage and improved quality of onions placed in storage could assure the supply until a new crop was ready.

Storage remains a problem. The onions must be ready and throroughly dried before being placed in storage. Those placed in storage should be arranged according to their probable storage life. Unlike processed food, a simple first in-first out rule is not enough for onions. If the rains come early the very last into storage may have to be sold within a few weeks of being placed in storage. Salpietra, in his 1971 report on marketing, suggested use of crates for onion storage and regrading before shipping to market. Both suggestions have much to recommend them.

The "Guía para el Cultivo de Cebollas" prepared by MAG is simple and direct. It is written for a much less sophisticated farmer than the pamphlets on potato and tomato production. It will probably be more useful to more farmers. It will also need to be backed up by extension agents. The

University report supports the general recommendations of the Guía and emphasizes the importance of storing only good quality, well conditioned onions.

General Comments on Cost of Production Studies for Other Vegetables.

The cost analysis for peppers, cabbage, lettuce, carrots and beets were also reviewed. These are all reasonable. The yield estimate for peppers and hence the net return seems highly improbable. I would think that yields one third of this weight would be more consistent with the yield of tomatoes. The selling price estimates for cabbage and lettuce surely under estimate the shrinkage during shipping and marketing. The practice of cutting leafy vegetables in the heat of the day and allowing them to stand in the sun in the field or along the roadside with no shade almost guarantees losses. Shading is the very least that should be practiced. Cooling at a collecting point so that field heat was removed before the produce was shipped to Panama would reduce losses very substantially.

Marketing and Related Services

The best beginning for comments on marketing is to quote from the Memoria de Labores del Ministerio de Agricultura y Ganadería, 1971-1972, p. 104 "Technical Assistance : The general

field of the behavior of (horticultural) crops after harvest, their physiology, pathology and pests in storage, as far as tropical products are concerned, is the orphan denied systematic study and concentrated extension work with the farmer. More than fifty percent of the markup between the producer and the consumer is the result of losses in weight, mechanical damage, and attacks of insects, disease and rodents". The Ministry has set attacking these problems as a major goal. It is a very desirable one and one which can use the talents of some of the most skilled investigators and effective extension agents and teachers available. One of the major problems is to convince each person in the marketing chain that he is losing and not simply passing the cost along to someone else. It begins with the farmer who grades with an easy conscience to increase the number of boxes or crates he has for sale. It is passed on by a wholesaler who tops crates of indifferent produce with that of better quality. It ends up with a consumer who pinches every tomato until he finds one with just the right firmness. Each losses in the long run, but none in the immediate transaction.

The reports by Fong on marketing of fruits and vegetables and on transport are key documents in any comprehensive analysis of the vegetable industry. The report by Salpietra covers the market information service and has some salient observations on the handling of produce.

In our trip to the field and around the city, we saw many problems. Lack of gathering and holding points permitting long distance transport to move quickly with full loads is a major need. The cooperative at Cerro Punta was providing this service and had truckers waiting for loads. No other such point was seen along the route from Panama to the Costa Rican border. Wholesale markets are places where truckers sell to retailers and not farmers' markets.

More information is needed on prices and market volume. One check point is now operating, Risacua just east of David. Other points recommended are Divisa and Arraiján. To this list I would add one more, At Gatuncillo, Buena Vista or Sabanita along the highway to Colon. Market reports should include movement and wholesale prices through 6 a.m. to be disseminated by 6 pm. or 7 pm. on the same day. The one market report heard was on the David radio station at 7 pm. This gave movement through Risacua and gross value by product. Perhaps earlier in the program unit prices were quoted. Both unit prices and range, according to quality, are needed. Some estimate of the supply available in the major markets, David, Chitré, Penonomé, Panamá and Colón would also be helpful, particularly if a glut was developing. Prices were posted on a public blackboard in David and in the Mercado Público.

Although crowded, the puestos in Mercado Público are efficient and from Fong's study an important factor in the Panama retail market. The wholesale market on the other hand is an accomodation to an almost impossible physical situation. All sales observed were directly from the truck. The streets were so crowded at 5:00 am. that passage was kept open by the police with great difficulty. Truckers could not unload their cargo and leave the area until they had sold their produce. If some went unsold, they either had to wait over another day or peddle it on the street,out of the immediate market area, as itinerant vendors. There may be some storage areas but we neither saw them nor were told of them.

Two ways are available to build a wholesale market and loading zone by the Mercado Público. One would be to condemn some of the adjoining buildings. This would be expensive and might be highly unpopular with those who were forced to move their businesses or homes. A second possibility would be to build the new market in the bay on either a pier or on fill. This would interfere with the present pier which would have to be replaced. Some improvement of the wholesale market is definitely needed but relief may be obtained by quite a different route.

A new market should be constructed, or at least the feasibility of construction should be determined. The city is growing eastward toward the airport. A logical location would be in the vicinity of the Estadio 70 or between Via José Agustín Arango and Via Domingo Diaz. Such a market should have both wholesale and retail facilities. Concessionaires should be encouraged to sell other merchandise and service in the same area, either in upper floors in the retail market or in adjoining buildings. Ample parking should be provided for trucks, delivery vans and autos, personal cars and public buses. Buses should be routed so that there is a stop at the retail market which would permit passenger to get off and into the market without being exposed to rain. Enough land should be acquired to permit doubling the facility at some later date.

After construction of the new market, when some of the pressure is relieved from the present facility, redevelopment of the old market area could be considered without complete disruption of the flow of fresh food. Unless the whole population pattern of the city changes drastically and within a short time, the old market will continue to serve a large number of people, especially those with lower income.

Frigo-Mag seems to be experiencing some difficulty. Operating losses have been high and the kioscos seen do not have a full line of fruits and vegetables. This does not

mean that the idea is without merit and should discarded. In the first place, it has allowed officials of the Ministry to learn first hand about the problems faced in marketing perishables. From the data obtained, a better estimate of the efficiency of the commercial channels will be possible. Second, the information can guide research, planning and regulation. Third, it is a reminder that the government is interested in both the farmer and in the consumer, especially the consumer with restricted income. It should serve as a warning to commercial distributors that they both enjoy a privilege and have an obligation to the public. If the service is not provided, the government is prepared to intervene.

The need for standarized shipping units, uniform methods of measuring quantity and quality standards have been recommended, in this and other referenced reports. These are all necessary but will not necessarily replace visual inspection by the purchaser. The purchaser of small quantities could probably be more easily and cheaply served by an agent who would both purchase on his behalf and deliver the produce to him and a number of other clients in a single trip from the market. Abarroterías, comisariatos and kioscos, could all be served by such agents and might form companies to contract

for the service and to purchase other items in wholesale quantities.

Losses in the wholesale market and at retail must be reduced. Much of the markup which hurts the farmer and consumer is caused by avoidable losses. An active extension program should be developed to give courses and on the spot advice on handling and merchandising produce. Storage facilities should be checked. Inventory/sales ratios should be examined and norms established according to volume of business, display, storage facilities available, and pattern of sales throughout the week. Large businesses such as the supermercados need this advice as much, perhaps more, than the kiosco operator who feels losses immediately because they come out his own daily income. Maintenance and temperature control in cooled display cases is extremely important and often not observed. Spoiled vegetables should be removed from displays regularly and disinfecting washes should be used when the bins are emptied at night, or by rotation, if the produce is stored overnight in the display area.

Only buffer storage to smooth out the difference between deliveries and retailer demand should be maintained in the wholesale market in Panama or other large cities. Both uncontrolled and refrigerated storage is needed. Good ventilation and humidity control are required for both. Loading docks at truck bed height and wide enough to allow free

passage with forklifts will be required. Although labor is still plentiful, the cost is rising rapidly and all new construction must be planned to permit minimizing labor requirements as costs change. This is not to suggest that automated handling should be installed in the near future.

Major storage should be in the producing areas, as it is now for potatoes and onions. This storage should be attached to collecting stations and have grading and packing facilities, as well holding areas. Produce should be held in bulk and loosely packed until it is prepared for final shipment. Crates should be used so that the produce at the bottom of the pile does not support the weight of that piled above it. Storage areas should be disinfected regularly and a regular schedule of rodent control should be followed.

The recommendations of Fong, beginning on page 29 of Mercadeo de Frutas y Vegetales, Oct. 1972 should be followed or at least seriously considered and rejected only for cause. Those of Salpietra in his 1971 report should also be followed, where they have not already been put in practice. In regard to these, I have one reservation. He recommends using any excess of onions for processing. I know of no successful processing venture which depends on surplus. Deliveries to processors must be more carefully planned than those to the fresh market because the margins for all concerned are much narrower.