



**AgEcon** SEARCH  
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

*The World's Largest Open Access Agricultural & Applied Economics Digital Library*

**This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.**

**Help ensure our sustainability.**

Give to AgEcon Search

AgEcon Search

<http://ageconsearch.umn.edu>

[aesearch@umn.edu](mailto:aesearch@umn.edu)

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

## AIR TRANSPORTATION OF PRIMARY PRODUCTS. POSSIBILITIES AND IMPLICATIONS.

BY

K. O. CAMPBELL, B.Sc.Agr.,

*Economics Branch.*

The extensive use of aircraft for transport of freight during the war period has focussed attention on the possibility of transporting a greatly increased volume of civilian goods by air in future. Perishable agricultural products appear to be one class of commodities which have potentialities as air freight. Such an advance in marketing technology, if it becomes a reality, is likely to have a marked effect on the production and distribution of perishables.

Several research agencies, conscious of possibilities in this field of transportation, have been conducting investigations during the past few years. Air transportation of primary products is, however, no longer in the blue-print stage. Large scale shipments of fruit and vegetables by air have already been made on a commercial basis. In the latter months of 1945, a regular service carrying 60,000 lb. of perishable produce per week was being operated between California and cities of Eastern United States using seven freight planes<sup>1</sup>. Small shipments of fruit and vegetables have also been made in this country.

### **The Advantages of Air Transport.**

The principal advantage to be gained by air freight is that it enables the quality of the product to be maintained during the marketing process. This is achieved by virtue of reduction in handling and faster delivery. This form of transportation is therefore most relevant where a long haulage from the producing area to market is involved. The success of air transport depends on ability to deliver a superior product.

As a hypothetical illustration of the saving effected, consider the transport of tomatoes from Bowen in North Queensland to the Sydney market. Last year, the volume of tomatoes which came from North Queensland-producing areas amounted to 800,000 half-bushel cases. This fruit, which is picked at the "mature green" stage takes a minimum of 5½ days to reach Sydney by rail, and two days longer if Melbourne is the destination. These times do not include the interval between harvesting and loading and the interval between reaching Sydney markets and the retail sale of the product in suburban or country shops.

By air, the time required for transit would be between 7 and 8 hours. Produce could be picked in the forenoon or afternoon of one day, loaded on a plane in the evening, transported to the consuming centre overnight, and placed in retail stores the day after harvesting. This would enable growers to harvest their produce at a much more advanced stage of natural ripening, resulting, in most cases, in a considerable increase in the palatability and vitamin content of their product and some increase in yield per acre.

<sup>1</sup>"Modern Packaging," Vol. 19, No. 3 (November, 1945), p. 96.

While the superiority of air-transported fruit in juiciness, flavour, colour and texture can be readily appreciated, studies have revealed a definite difference in chemical composition. Tests under American conditions have shown that air-borne tomatoes had 25.45 milligrams of Vitamin C per 100 grams of tomatoes as compared with 14.43 milligrams for rail-borne samples from the same crop. Hot-house tomatoes, at the same time, had a Vitamin C content of 13.18 milligrams per 100 grams<sup>2</sup>. Apricots, peaches and figs ripened on the tree and flown to market contained approximately one-third more sugar than those harvested 10 days earlier and transported in the usual way. All crops do not, however, benefit from faster means of transport. An experiment with grapes revealed no significant difference in either flavour or nutritional value between lots delivered by the two methods of transportation. The air-borne grapes did, however, have a somewhat fresher appearance than those carried by normal means. In the case of peaches, not only did tests reveal a greatly increased sugar content, but the fruit increased markedly in size during the last ten days before full tree-ripe maturity.



**Unloading Victorian Brussels Sprouts—Kingsford Smith Airport, Sydney.**  
Note Cardboard Cartons as well as Wooden Boxes. The former have been evolved to lessen freight costs.

[Photo by courtesy of "S.M.Herald." and A.N.A. Proprietary Ltd.]

Air transport not only offers possibilities from the standpoint of commodities at present carried by surface means, but also provides the means of creating new markets for many highly perishable commodities, which cannot be transported by existing methods. This applies particularly to berry and sub-tropical fruits.

<sup>2</sup>Larsen S. A., "Air-borne Perishables need Temperature Control," *Refrigerating Engineering*, Vol. 50, No. 1 (July, 1945), p. 17.

It appears also that, if air transport becomes of any great significance, we may have to revise our ideas concerning varieties of fruit and vegetables. Many of the outstanding varieties to-day are selected more for their good carrying characteristics rather than from the standpoint of eating quality. Many varieties of good eating quality are not grown commercially because they do not carry well. Plant breeders may have to reorientate their breeding programmes away from producing rugged varieties to stand up to traditional transport methods, and varieties which colour up days before they are ready to eat. Thus the consumer may be introduced to new standards of quality as well as to new fruits for his menu.

### **Effects on Producing Areas.**

Air transport may eventually have a profound effect on the existing pattern of producing areas serving particular markets. Producers will be variously affected depending on their geographical location and competitive position. The effect of carriage of perishables by air, together with modern developments in food processing such as quick-freezing, will cause the relative advantages of fruit and vegetable producers located close to large markets to decline in importance. These sections of the industry will be placed on a more strictly competitive basis with low-cost areas. At the same time, some producers will be able to ship their products to many markets not now accessible because of the limitations of existing transportation facilities. Likewise, new producing areas which cannot be opened up under present conditions, but which would otherwise be admirable from the production standpoint, will be enabled to begin production<sup>3</sup>.

In certain countries this change in production opportunities may encourage international transfer of perishables. Thus there is talk of shipment of ripe bananas from Central to North America by air. In our own case, New Guinea may offer possibilities for production of certain crops for southern markets in particular seasons. International shipment of a variety of fruit and vegetables, however, may introduce quarantine difficulties which may possibly result in regulations tending to restrict such traffic.

### **The Cost Differential.**

The most important factor determining the air cargo potential of fresh fruit and vegetables is the freight rates. Numerous studies have demonstrated that large-scale movement of perishables by air is dependent upon a substantial reduction in costs. At the present time, air transport rates are 20-25 times higher than railway rates for perishable primary products in Australia in several instances examined. It is significant, however, that during the war period, freight rates on some United States airlines dropped by over 50 per cent. of pre-war rates. Aircraft manufacturers are confident that costs can be reduced still further to levels at which a relatively large-scale movement of agricultural products will be possible.

---

<sup>3</sup> cf. Isard, C. and Isard, W., "Economic Implications of Air Transport," *The Quarterly Journal of Economics*, Vol. LIX, No. 2 (February, 1945), p. 164.

As an illustration of the effect of declining costs on the air transport possibilities of different commodities the studies of Larsen<sup>4</sup> are interesting. He has shown that, under United States conditions, some strawberries would be carried at a freight rate of 15 cents per ton mile. At a 10 cent rate strawberries and peaches would move and at 7 cents strawberries, grapes, peaches, cantaloupes, cherries, pineapples, plums, raspberries and avocados would move in volume. For vegetables, at the 15 cent rate, some tomatoes would move, at 10 cents tomatoes and beans would move, and at 7 cents tomatoes, lettuce, asparagus, beans, cabbages, peas, spinach, corn and cucumbers would move in volume. At 5 cent and 3 cent rates the variety is further expanded. The actual freight rates given are not of any great moment, but the figures demonstrate how declining freight rates have a differential effect in determining the various types of fruit and vegetables that can be economically transported by air. Furthermore, significant shifts in the amount of particular commodities which could be transported would be expected as freight rates decline.

Studies to date suggest that no great volume of agricultural produce is likely to move through normal air freight services. The so-called "common carriers" which serve the general public, follow designated routes and make scheduled stops. Agents and growers are not likely to be interested in small loads carried as part of a miscellaneous cargo on freight planes or in the cargo compartments of passenger planes. On the other hand, the "contract carrier" type of air transport operation in which service is limited to the transport of goods under specific individual contracts, makes possible certain economies in handling air shipments, which result in lower costs than are possible in the case of the common carrier<sup>5</sup>. For this and other reasons, this type of air transportation appears to be the most suitable for primary products.

The results of several cost studies suggest that airlines of medium size have unit costs as low as, or lower than much larger airlines and that a condition of constant costs seems to characterise the industry after a certain scale of operations has been reached<sup>6</sup>. This is significant because it means that economy of operation is not dependent on a company operating a large fleet of freight carriers.

To achieve most economical operation in carrying perishables, it would be almost essential that the contract service should be assured of return freight when flying from the market centre back to the producing area. This return freight, in most instances,

---

<sup>4</sup>Larsen, S. A., *Air Cargo Potential in Fresh Fruits and Vegetables, Wayne University Studies in Air Transport*, No. 1, Detroit, 1944.

<sup>5</sup>cf. "The Use of the Airplane as a Contract Carrier of Agricultural Perishables," *The Marketing and Transportation Situation*, November, 1944.

<sup>6</sup>Ibid. See also Crane, J. B., "The Economics of Air Transportation," *Harvard Business Review*, Vol. XXII, No. 4 (Summer Number, 1944), p. 501 *et seq.*

would take the form of manufactured products. An all-freight service could only succeed with difficulty without such interchange of commodities. While it seems reasonable to assume that a full load of agricultural perishables would be provided, there could not be the same guarantee as regards a full load of manufactured articles, especially at the time of commencement of such a service. The chance of getting a full load of return freight would be increased considerably if the centre producing the agricultural products were close to a city from which exports to overseas countries were made. The North Queensland coast offers possibilities in this regard.

Research shows that in order to justify the cost of air transportation between a manufacturing centre and an agricultural centre, they should be at least 750 miles apart. Preliminary investigation suggests that air-borne agricultural perishable products could compete most advantageously with surface-borne products when transported between 1,000 and 1,500 miles.

To ensure most satisfactory service, particularly from the standpoint of guaranteeing the continuity of cargo for return freight, it would probably be necessary to fly any route for the entire year. This presents problems in view of the seasonal nature of agricultural production. If potential traffic proved high some months and low during others, complications may arise. However, by varying the type of products carried, depending on local seasonal conditions and upon supply conditions in the metropolitan market, it may be possible to achieve some measure of continuity in the quantity of air freight. The actual centre from which the agricultural produce originates could be varied within a few hundred miles of the terminal airport without much difference in costs. This is one illustration of the flexibility of air transport as compared with rail transport.

In connection with the general cost problem, it should be remembered that absolute and relative costs are liable to be unstable at a time of rapid technological advance. This is particularly pertinent in the case of the aircraft industry when recent outstanding innovations in motive power are just coming into general use. These, together with progress in design, types of fuel and constructional materials, may bring about still more drastic reductions in costs of air transport than those achieved in recent years.

The possibility of competition from air transport may hasten various improvements in existing forms of transportation (boat, rail and truck) in the direction of increased speed, lower costs, and improved facilities for handling perishable freight. The railways may also offer lower discriminatory rates for perishable traffic in order to retain the existing business. All these reactions would affect the cost margin between the different forms of transportation. For these reasons historical cost data are not of much value in determining the precise amount of air traffic probable in the future.

**Consumer Reaction.**

The potential volume of air-borne perishables would also depend on consumer acceptance of such produce. This, in turn, is largely determined by consumer purchasing power, the general quality and prevailing price levels of the commodities in question and the relative prices and qualities of commodities transported by air and by surface means. The air-borne produce would have to sell at a sufficient premium over rail-borne produce to cover the added costs of transport.

Considerable study has been devoted to this aspect of the problem by investigators in the United States. Recent experiments indicate that there is a market under American conditions willing to pay the premium price. However, it is difficult to determine, from short-term observations, whether air-borne produce used in these experiments was bought at premium prices solely because of the novelty of the event. Sales of produce over a fairly long period would be necessary to gain information on this point. It is obvious that if the differential price is to be maintained, it must be based on the intrinsic superior quality of the air-borne product over its competitors. Although the superiority of the product can be demonstrated by physical and chemical tests (as outlined earlier), the ordinary consumer must be convinced that such a difference does exist before he will be prepared to pay the higher price.

There is some encouraging evidence that consumers will pay a differential price, solely on the improved appearance and quality of produce, without it being identified to them as air-transported.<sup>7</sup> The crucial point to be determined in any specific situation is whether the premium price paid is such that (a) consumers take a sufficiently large volume of produce to ensure payable loads, and closely connected therewith, (b) the margin is sufficient to cover the increased unit costs incurred in transporting the produce by air.

**Packaging Problems.**

Large-scale transportation of primary produce will necessarily mean a radical change in conventional methods of packing. Air shipment means less rough handling of produce while in transit than is the case with surface transport. At the same time, reduction in weight is desirable in order to achieve lower costs for air-freight. Thus there is a natural tendency to substitute various types of light-weight containers such as corrugated boxes for the traditional heavier wooden containers which are used essentially to protect produce while in transit.

The commercial development of air transport of agricultural perishables in America has been associated with the use of consumer packages. This means that produce is packed directly into consumer-size cartons in the producing area before being transported. Thus lettuces are individually wrapped in cellophane, tomatoes and similar products including fruit are put up in one-pound two-window cartons. Pre-packaging necessitates careful

---

<sup>7</sup> "Post-War Air Transport Costs and Markets for Lettuce," *The Marketing and Transportation Situation*, August, 1944.

selection of fruit at correct maturity and of high uniform quality. Apart from certain advantages to the retailer and consumer, the use of consumer packages is to some extent a protection against unscrupulous retailers selling produce which has not been transported by air, as air-borne produce.

There are special problems associated with the technical question of types and methods of use of consumer packages which cannot be discussed here. However, it does appear at this stage that successful commercial air transportation of perishables may be tied up fairly closely with the use of such packages.

#### **Reduction in Distribution Costs.**

In any discussion of air freight potential, consideration should be given not only to the relative costs of different forms of transport but also to possible economies which might be achieved in the distribution process. This question has not been very adequately examined as yet. However, it does appear that air transport may result in savings in this direction. For instance, use of lighter containers means a reduction in costs. Pre-packaging often results in more economic transportation as many commodities, especially vegetables, are thereby trimmed early in the marketing process. Consumer-packaging also permits certain economies from the retailers' standpoint. Moreover, there is evidence suggesting that air-transport may effect a reduction of the order of 50 per cent. or more in the spoilage, shrinkage and wastage which normally occurs with some perishables. One must also consider the additional receipts obtained by growers as a result of the increased yield achieved by allowing products to reach a later stage of maturity prior to harvesting.

Mature fruit and vegetables require special treatment in retail distribution. One of the vital elements necessary to the success of transporting fresh produce by air is the development of a scheme which will ensure rapid flow of perishable goods between wholesaler, retailer and consumer. It may be that pre-arranged contracts between growers and retailers will have to be made in advance. As a matter of fact, commercial air shipments of perishables in America to date have followed such a pattern. The produce has been handled by only three organisations—the grower, the carrier and the retailer—thus by-passing the wholesaler altogether. This effects savings in time and handling and enables agents' fees to be eliminated.

On the other hand, fresh produce deteriorates rapidly unless stored under cold temperatures and under certain conditions refrigeration may be necessary. The opinion has been expressed that the lower temperatures prevalent at flying altitudes are normally sufficient to preserve fresh produce in good condition. Experiments have shown that possibilities in this direction are not as great as was originally thought. Under American conditions, shipments which are pre-cooled for 6-8 hours and then transported at night without special cooling facilities, open up in sound condition. Flying at higher altitudes to take advantage of lower temperatures is discouraged because under present conditions to fly high in long hauls means much greater fuel consumption and resultant additional expenses. However, much



further information is required on the necessity for precooling and refrigeration on particular routes at particular times and on the costs involved before clarification of the issue will be possible.

### **General Conclusions.**

It seems that there are definite possibilities of development in the field of air transportation of perishables. Non-perishable farm products are not likely to be air-borne for many years to come. The carriage of perishables by air has certain advantages but the actual volume of potential traffic will be determined largely by the extent to which costs can be reduced to enable it to compete with other forms of transportation on more favourable terms.

There does appear to be some prospect of competition between air-borne perishables and quick-frozen fruit and vegetables, if the latter industry becomes established. The quick-freezing process does provide a means of supplying quality out-of-season produce. At the same time, quick-frozen foods have certain disadvantages from the distributional standpoint which would not be associated with air-borne perishables. Nevertheless, failure to achieve rapid movement of airborne produce through retail channels might give frozen foods a premium as regards freshness and quality. The extent of competition may vary from commodity to commodity. In the case of some commodities, air transport could not improve upon the frozen product; in others, airborne quality would be superior, and still other products have not yet been successfully frozen. There may also be a limited amount of competition from canned and dehydrated products but this does not appear to be so serious.

Air transport will not absorb in the immediate future any significant proportion of the total traffic in agricultural produce at present carried by surface means. Railways will not be materially affected by the inroads of air transport on their business. Air freight can only be regarded as supplementary to other forms of transport. At the same time, it does make possible the marketing of commodities which cannot be conveyed under existing conditions. Through its agency, the consumer may be enabled to enjoy fresh foods of greater variety and finer quality.

---

## **WORLD FOOD GRAIN NEEDS.**

BY

P. VAIDYANTHAN, M.A., M.Litt.,

*Economics Branch.*

### **The Extent of Food Grain Shortage.**

The Office of the Foreign Agricultural Relations of the U.S.A. Department of Agriculture estimated recently a reduction in 1945 of total world food production by 12 per cent. per capita below the pre-war average of 1935-39. This observation will not be very significant if it is not related to local production and the quantity needed for consumption in countries which have been