

COLD CHAINS IN ECONOMIC PERSPECTIVE
FUTURE SUPPLY AND DEMAND OF COLD CHAIN SERVICES

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1. INTRODUCTION

The market for cold chain services is complex. Supply comprises a great many different types of services. Demand is not only complex because of the variety of needs, but also since the demand for cold chain services is a derived demand.

In this paper on supply and demand of cold chain services no fresh quantitative analysis of this market will be given. It is intended to improve the understanding of future supply and demand of cold chain services by:

- presenting a framework for the analysis of the demand for cold chain services;
- developing an indicative forecast of future demand for cold chain services on the basis of relevant predictions of the demand for food and agricultural products;
- adjusting this tentative forecast, in a qualitative sense, for changes in consumers' wants and needs and in requirements of trade, in particular of retail trade;
- discussing possible changes in supply of cold chain services, as a result of changes in technology, and in costs of storage and transport;
- making some final remarks about the importance of logistical planning for the efficiency and effectiveness of cold chain services.

While it is tried to discuss developments which are relevant to all West European countries, our paper is in particular concerned with the situation in the Netherlands.

2. A FRAMEWORK FOR THE ANALYSIS OF THE DEMAND FOR COLD CHAIN SERVICES

The demand for cold chain services is a derived demand. Demand for cold chain services is a derivative of the demand for food and agricultural products whose quality maintenance in the marketing channel depends to a large extent on the use of cold chain services in storage and transport.

Demand for cold chain services can be specified by the following conceptual framework:

$$\begin{aligned} D(\text{Cold Chain Services}) &= D(\text{Food Quantity}) \cdot Q(\text{Food Quality}) \cdot G(\text{Food Trade}) \\ D(\text{Food Quantity}) &= DFC(\text{Food Quantity}) \cdot P(\text{Size}) \\ DFC(\text{Food Quantity}) &= F_1(\text{Income, Prices, Attitudes, Habit Formation}) \end{aligned}$$

- Q(Food Quality) = F_2 (Income, Attitudes, Habit Formation, Prices of Services)
- G(Food Trade) = F_3 (Concentration in Retailing, Concentration in Production, Pr(Cold Chain Services))
- Pr(Cold Chain Services) = F_4 (Prices of Inputs, Type of Technology, Logistical Operations)
- for: D(...) = total demand,
 DPC(...) = demand per capita,
 Q(...) = quality of food demand,
 G(...) = geographic area of food trade,
 PR(...) = price,
 P(...) = population size.

The model will serve as a conceptual framework and will not be estimated. The model implies that supply of cold chain services is adapting to developments in demand. It is assumed that suppliers of cold chain services have no strong market power.

Cold chain services include various services - transport, storage and other services - which are measured physically in a different way. Only in terms of money they can be expressed in one measure. But also if measured in terms of money, Cold Chain Services can not be separated easily from other marketing and logistical efforts.

Another difficulty in measuring expenditure for cold chain services is that changes in consumers' food expenditure - keeping quantity purchased constant - are concerned both with changes in demand related to cold chain services and with changes in demand related to other services and food quality, like better taste and/or higher nutritional value.

Consequently, it is impossible to forecast demand for Cold Chain Services accurately and our analysis has to be of a semi - quantitative nature. First, a forecast is made under the assumption that demand for Cold Chain Services is developing proportionally to the demand for food, other things remaining equal. Afterwards this tentative forecast is adjusted for qualitative changes in consumers' demand, for changing policies of retail trade and for changes in the location of agricultural production.

Finally some attention will be paid to change in supply of Cold Chain Services, as a result of changing technology and costs.

3. DEVELOPMENT IN FOOD DEMAND, IN PARTICULAR OF FRESH FOOD PRODUCTS; IMPACT ON DEMAND FOR COLD CHAIN SERVICES

Developments in the volume of consumption

Various projections of demand for food and agricultural products in 1990 in EC countries have been made. A fairly complete projection of the demand for agricultural products in 1990 is made by Boddez and Ermens (1982) and the EC commission (1985). Projections of food demand beyond 1990 are scarce. For the Netherlands, projections of the demand for food and agricultural products in 2000 are available. Some projections of Boddez and Ermens (1982), being relevant to our purpose, are following (per capita figures within brackets):

- annual demand for meat in the EC (9 countries) is increasing over the period, 1978 - 1990 by 1.5% (1.2%). This figure is larger for pork, 2.0%

(1.8%), and poultry meat, 2.1% (1.9%), and smaller for beef and veal, 0.3% (0.08%).

- annual demand for milk in the EC (9 countries) is increasing over the period 1978 - 1990 by 0.50% (0.31%) for 'fat', and by 0.90 (0.66%) for 'non-fat'. This figure is larger for cheese, 1.6% (1.4%), and cream, 1.6% (1.4%) but smaller for fresh milk products, 0.1% (-0.1%), and butter, -0.1% (-0.3%).

Projections of the growth of total demand for fruits and vegetables in the EC (10) published by the European Commission (1985) are (per capita figures within brackets):

- annual demand for vegetables in the EC (10 countries) is increasing over the period 1982 - 1990 by 1.2 % (1.1%).
- annual demand for fresh fruit in the EC (10 countries) in the period 1982 - 1990 is projected to increase by 1.2% (1.1 %). This figure is projected to be higher for apples, 2.8% (2.5%), and peaches (fresh and processed), 2.0% (1.6%).

Kortekaas a.o. (1987) projected for the period 1984 to 1990 an increase of sales for some Dutch vegetables (tomatoes, cucumber, pepper, and radish), both domestic and exports, of 21.9 %, which is a little bit more than 2% annually. Sales of Dutch cut flowers and pot plants is projected by the same authors to increase by 16.5% and 30.8% over the period 1984 - 1990, which amounts to about 2% and 3% annually.

Forecasts of food consumption in the Netherlands for the year 2000 are of a more general character. Alessie a.o. (1987) projected an increase in total food consumption of 21% over the period 1980 -2000, which is about 1% on an annual basis.

Douw and others (1987) projected an increase of annual sales potential of Dutch agriculture of 0.5% - 1.0% over the period 1985 - 2005. They made forecasts for the periods 1985 - 1995 and 1995 - 2005 and for various product groups separately. Annual growth rates of sales are projected to be higher for horticultural products grown in glasshouses (in the period 1985 - 1995 2.5% for vegetables and cut flowers and 5.5% for pot plants and in the period 1995 - 2005 1.5% for vegetables, 2.5% for cut flowers and 4.5% for pot plants), than for ornamental plants and flowers grown in the open air (during both periods an annual growth rate between 1% and 1.5%), fruit and vegetables grown in the open air (in the period 1985 - 1995 an annual growth rate for fruit of 0% and for vegetables of 1%, and of 1% for both product groups in the period 1995 - 2005), and pork and poultry meat (an annual growth rate for pork of 1.5%, and for poultry meat of 2% in the period 1985 - 1995 and of respectively 1% and of 1.5% in the period 1995 - 2005).

Other forecasts of total demand for food products in the Netherlands, which are relevant to the demand for Cold Chain Services, has been made by the consulting firm Broers and Partners (1986). Their forecasts are more modest than those of Douw a.o. (1987): total consumption in 1985 being 100, it is predicted to be in 2000: 98 for potatoes, 108 for vegetables, 109 for fruit, 108 for meat and 109 for fish.

The projections of Roddez and Emens and the European Commission, in particular for fresh meat and vegetables, suggest that the demand for Cold Chain Services in the EC will, other factors remaining equal, increase until 1990 annually by about 1% - 1.5%. The increase of conditioned transport of food products in the Netherlands over the period 1985 - 1990 is projected by Broers and Partners (1986) to be smaller: between 4% and 6% for fresh products and between 6% and 8% for quick frozen food, which is somewhat less than 1% on an annual basis (Broers en Partners, 1986).

Forecasts of total food consumption and of sales of specific food products in the Netherlands suggest, other factors remaining equal, an annual rate of growth of about 1.5% in the demand for cold chain services in the period 1990 - 2000.

As mentioned already, we do not dispose of a complete set of projections of food consumption in EC countries in 2000. Nevertheless foregoing forecasts of food consumption in the Netherlands might be relevant for other west european countries. Also for other EC countries a modest growth in gross national product is projected. Gross national product is expected to increase in the period 1988 - 1992 annually by 1.75% in the United States and by 2.5% in other industrialised countries (Centraal Economisch Plan 1988). It is expected that after 1990 growth of the gross national product in industrialised countries will recover. A combination of gross national product with small income elasticities of demand for food products suggests in these countries a small increase of the demand for food products which are relevant to cold chain services as well.

Quality of food consumption; impact on demand for Cold Chain Services

Demand for Cold Chain Services is a derived demand. It is not only influenced by the volume of food consumption but also by the type and quality of food-consumption. The foregoing discussion on the volume of future food consumption has been centered already on food products relevant to cold chain services. The forecast by Broers and Partners of the demand for conditioned transport in the Netherlands was based on a forecast of the demand for specific products like quick frozen potato products, fresh and quick frozen vegetables, quick frozen fruit, fresh and quick frozen fish and meat products.

However, the effect of changes in consumers' attitudes and preferences for specific product types and for specific product qualities and services cannot be predicted so easily. The market for specific types and specific qualities within generic product class are marketing opportunities. They require adequate marketing policies of producers and traders, in order to be captured. For instance, to what extent consumers' demand will shift from canned to fresh or quick frozen vegetables as a consequence of changing consumer preferences, depends to a large extent on marketing policies of suppliers. Therefore shifts in demand toward specific product qualities and product services, which have an impact on the demand for Cold Chain Services, will be analysed largely in a qualitative sense.

Quality requirements of consumers stimulate consumers' demand for built in services and for better qualities of the same product. For instance, in the United Kingdom income elasticity of food expenditure is larger than income elasticity of food-quantity purchased (Ministry of Agriculture, Fisheries and Food, 1987). Differences are larger for products which have small income elasticities of demand for food-quantity purchased -, say 0.15 or less. In West Germany income elasticities of expenditure and of quantity purchased differed not so much in 1980 (Filip, 1983).

Do consumers prefer fresh food products? De Haen, Murty and Tangermann (1982) estimated, on the basis of annual data over the period 1960 - 1972, for the EC (9) countries with the exception of Denmark, Ireland and Belgium/Luxemburg, higher income elasticities for fresh vegetables than for processed vegetables.

In the Netherlands consumers prefer fresh vegetables to canned vegetables in particular since they consider nutritional and sensoric value more important for fresh vegetables and additives more important for canned vegetables (Steenkamp, Wierenga and Meulenber, 1986). Also german consumers

esteem highly fresh, natural vegetables (Deters, 1986). During the period 1973 to 1978 the share of expenditure for fresh vegetables in total vegetable consumption increased by 1.3% (Filip, Wöhlken, 1984), but does not seem to have increased further over the period 1978 - 1980 (Filip, 1983).

In the United Kingdom income elasticities of demand are larger for fresh vegetables than for canned vegetables (Ministry of Agriculture, Fisheries and Food, 1987): in 1986 income elasticity of demand for fresh green vegetables and for other fresh vegetables was respectively 0.17 and 0.31, and for canned vegetables -0.01 only. The income elasticity for frozen peas was substantial yet, 0.33.

Also in some west european countries there is a growing interest in fresh meat as compared to processed meat. In the United Kingdom income elasticities of demand for carcase meat are larger than income elasticities for other meat and meat products: 0.27 as against -0.01 (Ministry of Agriculture, Fisheries and Food, 1987). The income elasticity of the demand for frozen convenience meat and meat products in the United Kingdom is even negative, - 0.29. In West Germany however the share of fresh meat and meat products in total meat expenditure was stable over the period 1965 - 1980, respectively 49.6% and 48.3% for fresh meat and 50.4% and 51.7% for meat products (Filip, 1983). In Belgium consumers prefer fresh meat to prepacked meat. They consider the latter less fresh; for Belgian consumers freshness is the most important evaluative criterion choosing meat (Vandercammen and Viaene, 1988).

In the Netherlands no substantial shift from the consumption of meat products towards consumption of fresh meat can be observed. The relative importance of quality attributes, like nutritional value, food additives, energy and sensoric evaluation did not differ a great deal for meat served with the hot meal - fresh meat-, and meat products - processed meat - (Steenkamp, Wierenga and Meulenbergh, 1986).

So, it seems to us that increasing quality consciousness of food consumers has a positive influence on the demand for Cold Chain Services, because of the preference for fresh food. The quantitative effect of this influence is substantially smaller than the influence of the projected annual increase in total consumption of vegetables, fruits, meat and fish by 1.0 % - 1.5%. In the United Kingdom it might amount to annually 0.2%, considering the differences in income elasticities of fresh and processed vegetables and fresh and processed meat respectively and assuming an annual per capita increase of income of 2%. However, it should be stressed again, that changing consumers' attitudes and preferences offer marketing opportunities to producers and traders of fresh meat and vegetables, which can be materialised by adequate marketing policies only. Therefore these developments in consumer behaviour will accelerate the use of Cold Chain Services as a competitive marketing weapon.

Quality needs of retail companies; impact on demand for Cold Chain Services

The consumer is the ultimate decision maker with respect to the demand for food products, both in terms of product type, -quality and -quantity. But in respect to the demand for cold chain services, policies of retail chains are important too. Demand of retail companies for Cold Chain Services will increase for various reasons.

- Food retail business will concentrate further. It is predicted that market share of large national and regional chains in food retailing in the Netherlands will increase in the period 1985 - 1995 from 58% to 66.5% (Prodis, 1988). Presumably the same trend exists in other west european countries. As a result retail companies will purchase products in a large,

often international area. Quality maintenance by using cold chain services becomes more important because of larger transport distances.

Also demand for cold chain services is stimulated by marketing policies of big food retail companies. Fresh food, like produce, fresh meat, liquid milk and fish, are attractive items to differentiate a shop from competitors. For instance, in order to differentiate its business by high quality produce some supermarket chains request specific product temperatures at receipt. Selling fresh food requires more skill than selling groceries.

Also fresh food items are attractive to retail chains since they are traffic builders in the shop and have more attractive margins than groceries.

Purchasing tactics of big retail chains have a positive impact on the use of cold chain services as well. For competitive reasons big retail companies create new suppliers in order to depend less on a few domestic suppliers. This implies a geographic extension of purchasing by retail chains.

- Cost reduction is another central policy issue of retail chains. Logistical planning and quality maintenance are helpful in cost control. In this respect cold chain services are helpful by diminishing product losses.

Change in location of production; impact on demand for Cold Chain Services

Intra-community trade of meat has increased during the first twenty years of the EC. At present it amounts to 20% of total consumption in the EC for beef and pork and is less for mutton, 11%, and poultry meat, 9%. Apparently in the community regional specialisation in production of beef and pork is greater than specialisation in production of poultry meat and mutton. It is expected that intra-community trade will balance in the future at the level of 1/6 of total consumption in the community (Commissie van de Europese Gemeenschappen, 1987). Manure problems of dutch pig and poultry industry will curb off Dutch expansion in international trade of pork. Consequently further regional specialisation in production of meat does not seem to be of great importance to future demand for cold chain services.

For fresh horticultural products an increase in intra-community trade is expected, in particular at the end of the transitional period of the Spanish and Portuguese membership. For instance, Jahn (1987) concluded under specific assumptions that Spanish production of vegetables might increase by 49% (1982/83=100) in the period 1982 - 1995. This expansion as a consequence of the production potential in that country, will stimulate exports to northern EC countries.

In a theoretical study about the future of vegetable production in glasshouse in North Western Europe von Alvensleben (1986) assumes alternative increases of spanish exports with 40% or 60%, i.e. 400.000 and 600.000 tons.

Consequently the shift of vegetable production within the EC to mediterranean countries will definitely influence the demand for Cold Chain Services. Analyses of Jahn and von Alvensleben indicate the potential importance of this influence. However, to what extent growth-potential of horticultural production and exports will come into effect depends on the marketing operations of these countries and on EC policies with respect to horticulture.

4. ASPECTS OF SUPPLY AND COSTS OF COLD CHAIN SERVICES

Supply of cold chain services will adjust to demand for these services.

It will be influenced also by available capacity and by developments in technology of Cold Chain Services. Therefore, in order to complete our picture of the market of Cold Chain Services, some aspects of available capacity and of technology of Cold Chain Services will be reviewed, in particular in relation to costs.

Cold storage

An intercountry study of the EC in 1980 reported a total refrigeration capacity in the EC (9, exclusive Luxemburg) of 26.9 million m³. Largest capacities were available in the United Kingdom and Italy. In most countries stores had a freezing capacity of - 18 °C or below. This was the case to a lesser extent in France and Italy. The reason for this difference might be that in the latter countries storage of fresh fruit and vegetables, which are not stored at very low temperatures, is more important than in other EC countries.

Freezing capacity owned by the largest operator was at that time in particular high in Ireland - 40% of total capacity -, was substantial in Denmark, France, and West Germany - 30%...< 40% -, and was small in Holland and Italy, -less than 10% -. The use of capacity of these stores in 1977/1978 suggests that available capacity was sufficient at that time. There was even a tendency towards overcapacity: while a utilisation percentage of 90% seems attainable in cold storage warehouses, the use of capacity was estimated at that time to be less than 70% in France and Italy.

The minimum size of an efficient operation was suggested to be 30,000 m³, the average capacity of public cold stores in France and Holland was substantially lower, respectively 12,700 m³ and 11, 600 m³. This fact suggests that efficiency of cold store operations in 1978/79 could be improved substantially.

To our knowledge there are no recent surveys on cold storage capacity in the EC. So we limit our discussion on the evolution of cold storage warehousing to the Netherlands. Public cold storage capacity has increased in that country from 1.3 million m³ with 111 stores in 1975 to 2.7 million m³ with 130 stores in 1984 (Pronk, 1984). In 1984 expansion projects were under way. Concentration in cold storage warehousing increased from an average capacity of 11,400 m³ in 1975 to 20,450 m³ in 1984. However, this average capacity of 20,450 m³ per store is still below the suggested criterion of 30,000 m³ for an efficient operation.

An interesting development for horticultural products in the eighties has been the installation of cooling equipment at Dutch horticultural auctions. Products are cooled during a short period in order to maintain product quality throughout the marketing channel. Meffert (1985 b) reported in 1985 a precooling capacity for vegetables of 120,000 tons in 1979, of 835,000 tons in 1985 and projected a capacity of 1.8 million tons in 1990. Tomatoes, cucumbers and peppers are cooled to temperatures between 8 and 14 °C, and leafy vegetables, like lettuce and endive, to temperatures between 0.5 and 4 °C. In 1985 and 1986 The Central Bureau of the Horticultural Auctions has issued minimum delivery temperatures for various fresh vegetables. This system not only is useful for quality control, but increases also the flexibility of storage and transport operations.

An important technological development in storing fresh fruit has been the increase of CA storage at the expense of cold storage.

Cold storage of fresh carcase meat before transport takes about 24 hours. In view of the limited period fresh meat maintains its quality it is important to shorten this period. In the Netherlands it is allowed to load fresh meat for transport at 14 °C, instead of loading at 7 °C in earlier times, provided that the truck has adequate cooling facilities. This method, which shortens cold storage time of fresh meat before transport is attractive for international transport of fresh meat (Broers en Partners, 1986). The use of cryogenic cooling might be useful in this respect.

A new technique, developed in Denmark, cooling of meat at -1 to -2 °C in combination with vacuum packaging seems another promising method to extend quality life of fresh meat (Broers en Partners, 1986).

Storage of milk and dairy products is in particular important for butter and cheese. As a result of present EC dairy policy cold storage of butter is decreasing, which may stimulate overcapacity in cold storage. Efficiency of conditioned storage of cheese is improving, amongst others, by more efficient handling of cheeses during aging.

In the Netherlands developments in cold storage of fresh food, in particular in cold storage techniques, will not generate a large autonomous increase in supply of cold chain services. Improvements in cold storage operations are concerned in particular with a better coordination of cold storage with transport and other logistic activities, both from the point of view of costs and of product quality.

Conditioned transport

Conditioned and cooled transport of fresh food is very important. It is gaining importance because of the increasing concern in food marketing about quality control. This point has been discussed already. In the following section developments in conditioned and cooled transport will be reviewed, in particular with respect to the Netherlands.

Conditioned transport of perishable food products is very important. Depending on the computational methods used, 55% - 88% of Dutch exports of perishable products was handled by conditioned transport in 1985 (Bakker 1987, Meffert, 1987). Like in the case of cold storage, no fundamental changes in techniques of cooled and conditioned transport are expected in the near future. Methods of conditioned transport are changing primarily in order to fit transport better to changes in storage and/or precooling.

In order to transport fresh meat over larger distances, coordination of cooled storage and transport has to be improved. Adequate cooling facilities of trucks in combination with precooling of fresh meat before loading at a temperature of 14 °C, instead of 7 °C, are a case in point.

Meffert (1985 b) argues that amongst others an increasing supply of light cargo and an increasing supply of cooled and precooled products require technical changes in transport systems of fresh vegetables and ornamentals.

Also with respect to milk and dairy products no fundamental change in the technique of conditioned transport is reported.

Costs of cold chain operations

It is generally agreed upon that an integral cost approach is necessary in Cold Chain Services: in order to lower distribution costs conditioned transport, cold storage and handling have to be coordinated throughout the marketing channel. Actually this is a central task of logistical planning. Published information on costs of cold chain services mostly concerns either storage or transport separately.

In the EC study on cold storage warehousing (Commission of the EC, 1980) costs of cold storage warehouses in various EC countries are reported. The breakdown of cold storage costs shows clearly the capital intensive character of cold storage warehousing: labour costs varied between 23% and 36% of total costs in various countries and interest & depreciation between 31% and 58%. It appears that fixed costs are relatively important in total costs. It is interesting to notice that labour costs for dutch storage and warehousing in general amounted in 1985 to 36% of total costs, while the same percentage was reported for Dutch cold storage warehouses in the EC document as of 1980 (Commission of the European Communities, 1980; Centraal Bureau voor de Statistiek, 1987).

Methods to cool products less intensively before transport and at the same time improving cooling capacities during transport, like the one suggested for fresh meat, might decrease capital investments in warehouses and consequently decrease fixed costs of cold chain operation. For perishables it will be tried to diminish storage costs by better production planning throughout the year and by more international trade.

Van Nieuwenhuizen (1986) compared transportation costs of fresh vegetables for different types of vehicles. Assuming a vehicle having a capacity of 28 pallets and producing 100,000 km annually, transportation costs amounted to 9.4% of the value of cargo (assumed to be 25000 guilders) for a tarpaulin vehicle, respectively to 10.8% for an isolated vehicle and 11.7% for a refrigerated vehicle (Van Nieuwenhuizen, 1986). This result shows that a shift towards isolated or refrigerated transport has a limited effect on total channel costs, but causes substantial changes in transportation costs. It demonstrates the need to spread costs and revenues of a superior transportation method over all participants of the marketing channel.

In an analysis of total logistical costs of the marketing channel for fresh vegetables, both in the case of refrigerated and of non refrigerated transport, Meffert concluded that total logistical costs were larger for non-refrigerated transport because of greater losses in the latter case (Meffert, 1985 a).

These research results also show the need for a total channel approach in order to evaluate the impact of a change in transportation method properly. It illustrates the generally held opinion that cold chain services for fresh food will have to improve at present in particular by systematic logistical planning throughout the marketing channel. Adjustment between methods of transport, storage and materials handling is the basis for efficiency and quality maintenance. Effective and efficient information collection and information transmission is necessary for that purpose.

Effectiveness and efficiency of Cold chain services will profit also from flexible national and international legislation and agreements, like ATP. The advent of an open EC market in 1992 might be helpful in this respect.

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L'OFFRE ET LA DEMANDE FUTURES DES SERVICES DE LA CHAÎNE DU FROID

RESUME : Dans les pays occidentaux, la chaîne du froid offre des services dont les besoins augmenteront probablement plus que prévu à cause de la croissance continue, bien que modeste, de la consommation de denrées : entre 1 et 2 % jusqu'en 2000, d'après les enquêtes faites dans les pays de la CEE. Les arguments en faveur de ce point de vue sont les suivants :

On peut supposer que la demande de produits frais comme les légumes, les fleurs, la viande fraîche, les desserts et produits laitiers et la demande des aliments congelés, augmenteront relativement plus que la demande des autres produits alimentaires comme les conserves appertisées ou l'épicerie sèche.

Les commerçants, en particulier les détaillants, et les consommateurs demanderont davantage de services de la chaîne du froid. La logistique du stockage et du transport frigorifiques améliorera l'efficacité et par conséquent leur position concurrentielle. La conséquence de ces évolutions favorables à une demande complémentaire des services de la chaîne du froid est difficile à apprécier, parce qu'elles dépendent des efforts de commercialisation des sociétés de service frigorifique, qui doivent mettre en place des stratégies efficaces.

DISCUSSION

Question of Meffert, H.F.Th., Shrenner Instituut, Wageningen, The Netherlands
 My question concerns possible changes in the food consumption pattern in the European Community and their impact on conditioned transport.
 Contrary to the consumption of meat the consumption of vegetable exhibits great differences between the mediterranean countries (ca. 135 kg/cap.) and the northern part of Europe (ca. 80 kg/cap.). Are there indications that the northern countries are developing towards a (healthier) consumption pattern with more fruits and vegetable? Does this add to the needed volume of conditional transport towards this countries more than the total growth projection indicate under par. 3 of your paper.

Answer

The demand for fresh fruit and vegetables will increase amongst others because of the attractiveness of these products in terms of being low calory food, tasty, natural and - at least for some products - rich in vitamine C content. Also it may be expected that prices of fresh fruit and vegetables will, at least relative to other food, decrease because of the expansion of production in mediterranean countries and the consequent increase in competition in West european markets. Consequently there seem more opportunities to increase consumption of fresh fruit and vegetables at the cost of other food in northern countries than in southern countries, since per capita consumption of fruit and vegetables is less in the former country than in the latter. This potentially larger increase in northern countries will be enforced by the fact that health consciousness with respect to food seems stronger in northern than in southern countries (we are not familiar with research results supporting this view).

Foregoing arguments suggest a relatively stronger growth of demand for fresh fruit and vegetables in northern than in southern countries. It will stimulate the demand for Cold Chain Services too. To a certain extent this development has been included in the econometric analyses which served as a basis for the quantitative forecasts reported in chapter 3 of the paper. These econometric analyses are based on time series data of annual per capita consumption which include the developments discussed as they happened during the past too. It should be stressed however that the somewhat lower level of fruit and vegetable consumption in northern as compared to the southern countries and the positive attitude with respect to fruit and vegetables in Northern countries are marketing opportunities, which can be fully captured only by adequate marketing policies, in particular with respect to product and price. In this respect the suggested stronger rate of growth in the demand of fruit and vegetables in Northern countries is hard to predict.