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NUTRITIONAL AND DIETETIC REQUIREMENTS OF THE INDIVIDUAL AND SOCIETY: AN AGRICULTURAL ECONOMIC PERSPECTIVE*

by

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1. INTRODUCTION: MAN AND FOOD

Food is one of man's most basic needs. In the absence of adequate and proper nutrition it is hardly possible to achieve the higher aims of human existence dictated by religious, ethical and aesthetic considerations. An empty stomach knows and acknowledges no conscience. A community lacking adequate and proper nutrition is characterised by poor health, low general productivity and social unrest.

Nowadays there are great and important differences between nations and countries as regards food supply and food supply structures. Over the years some nations have experienced drastic changes in this regard. Standards of living have an important effect on standards of nutrition.

In the developed countries of the world food production and supplies have increased more rapidly than the population. Eating patterns and habits have also changed drastically. Traditional foods have been replaced by other, usually more processed, foodstuffs.

These changed patterns have resulted, *inter alia*, in ever-increasing quantities of agricultural products being used as intermediate inputs in the production of other food products. For example, the per capita cereal availability in the USA totals 900 kg; of this amount approximately 70 kg is used directly in the form of bread, confectionery, flour products, etc. The remaining 830 kg is used in the form of animal feeds in the production of meat, dairy products and eggs, the consumption of which rises as incomes rise (Power & Holenstein, 1976, p. 15).

In contrast with this, the annual per capita cereal availability in the poorer countries is approximately 180 kg, or one fifth of that of the USA. The same total quantity of food consumed by 210 million Americans could feed 1 500 million Chinese. Conversely it has been stated that if the entire world population adopted American eating patterns the available world food supplies and

production could only feed about 1 000 million people (Power & Holenstein, 1976, p. 15).

In an analysis of population growth and increases in food production in 71 less-developed countries between 1953 and 1971 the following findings were made (Power & Holenstein, 1976, pp. 39-43):

- In 24 countries food production increased more slowly than the population. Eight of these countries were in Africa (Algeria, Zaire, Tunisia, Mauritius, Dahomey, Uganda, Nigeria and Kenya).
- In 17 countries food production kept pace with population growth, but not with the increase in the local demand for food. This group included three African countries (Ethiopia, Mocambique and Zambia).
- In 30 countries food production increased more rapidly than local demand. Fourteen of these countries were in Africa (Angola, Central African Republic, Malagasy, Tanzania, Senegal, Gabon, Egypt, Ghana, Rhodesia, Sudan, Malawi, Upper Volta, Ivory Coast and Togo).

In less-developed countries undernourishment is a major problem. According to Mayer (1976, pp. 16-17) the calorie intake per person in many parts of the world is insufficient for normal requirements. This includes almost the whole of Africa, with the exception of certain southern African states and Libya.

The food problem is, however, of greater magnitude. Even in prosperous countries some people are living below the breadline, although per capita food supply for the population seems fairly good. Poorer groups are frequently unable to afford sufficient food.

There is also a difference between undernourishment and malnutrition. Malnutrition can arise in four ways (Mayer, 1976, p. 14):

- Undernourishment results when a person eats too little food.
- A person's diet may lack one or more essential nutrients. This may lead to deficiency diseases such as kwashiorkor, pellagra, scurvy, etc.

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- A person may be in such a condition (possibly through illness) that his body cannot digest food or absorb nutrients.
- Overfeeding consists in consuming too much energy or too much of one or more nutrients. This type of malnutrition is usually found among prosperous people. Unbalanced diets, which are too high in energy, fats, sugar and salt, contain too little fruit and vegetables and are based largely on highly processed foods, contribute to the incidence of diseases such as obesity, diabetes, hypertension and heart diseases, as well as marginal deficiencies in certain minerals and the B vitamins.

As regards the consumer the food problem therefore has several facets. Adequate food availability does not necessarily lead to adequate nutrition.

Certain writers (*inter alia* Mayer, 1976, p. 15 and Russett *et al.*, 1964, p. 199) consider infant mortality to be one of the best indications of feeding status (including quality). It is interesting to note that the USA, generally considered to be the most developed industrial country, does not have the best fed population according to this criterion. In 1950 the American infant mortality was the 5th lowest in the world; in 1968 it was the 13th lowest. In addition there are many other indications that American eating habits have worsened, especially during the 1960's (Turner, 1970, pp. 1-2).

In less-developed societies the problem is twofold: the availability of food and guidance in its correct use.

In developed societies the problem is probably largely the adulteration of food and a lack of knowledge or awareness of what proper nutrition involves.

South Africa is a microcosm of the developed and the less developed. The nutritional challenge here is therefore more complex and more diverse than in most other countries.

2. FOOD, AGRICULTURE AND TRADE: A COMPLEX SYSTEM

Man began and developed agriculture in order to meet his basic requirements, especially in regard to food. Schultz (1974, p. 236) puts it like this: "Nature is not in the habit of being bountiful. She is, in fact, niggardly in satisfying man's food requirements. Driven by necessity, man invented agriculture, an invention that reduces the niggardliness of Nature. Agriculture has been altering the natural environment ever since it was first practised, and the alterations associated with agriculture have benefited man by enhancing his capacity to survive and by making it possible to produce enough food to develop a long series of different civilisations. Modern agriculture is reducing to a remarkable extent the fraction of human effort that is required to satisfy the demand for food."

It appears that civilisation itself is rooted in the ability of farmers to produce and deliver more

food than they themselves could use. This made it possible for people to live in towns and cities, which led to specialisation of labour and differentiation of occupation. The industrial revolution in Great Britain followed an agricultural revolution which began about a century earlier. This type of relationship means that agriculture and other sectors are interdependent. The rest of the population is dependent on agriculture for primary food production, and also for certain industrial raw materials. Modern agriculture, in turn, is dependent on other sectors for the marketing of its products and for modern farming inputs.

This interdependence has been recognised for many years; Von Thünen's book *Der Isolierte Staat* which appeared as early as 1826, develops the economic location theory based on this relationship. A short summary of his field of interest is given by Roll (1950, p. 360): "A very large town is situated in the middle of a fertile plain which has neither canals nor navigable rivers. At a considerable distance, the plain ends in an uncultivated wilderness. The town draws its produce from the plain, to which it supplies manufactured products. How in the circumstances will the agriculture of the plain be arranged?"

Modernisation of agriculture and the development of other sectors (industrialisation) go hand in hand. Herein lies the difference between developed countries and less-developed countries. In less-developed countries industrialisation is at a low level and agriculture tends to be relatively self-sufficient in contrast with the highly commercialised agriculture in developed countries. As a matter of fact, Mosher (1971, pp. 5-8) claims that only where agriculture is self-sufficient are the terms "farming" and "agriculture" synonymous. In a modern economy every farm becomes a factory in which different inputs, drawn from the entire economy, are used. Commercial agri-support activities, consisting of the manufacture and distribution of farm inputs, marketing and processing services to process farm produce and credit structures form another important component of a modern agricultural sector. A third important component is made up of non-commercial agri-support activities supplied by the authorities: extension, research and regulatory services. The fourth component is the agricultural milieu, consisting of factors affecting the above three components, but jointly part of the entire economy: economics, political and socio-cultural factors.

It is therefore useful to think of a food system incorporating the following:

Farming
Supply and manufacture of farm inputs
Marketing and distribution of food
Processing of food
Research in connection with the above
Extension to farmers
Guidance to trade and industry
Guidance to consumers
Regulatory services

South African agriculture has a dualistic structure: on the one hand there is the developed agricultural sector, largely involving White farmers. This agricultural sector comes up against the same typical problems as those experienced in developed agriculture in North America, Western Europe and Australasia. Its achievements are also similar, although not necessarily of the same order.

Over a period of 21 years the volume of production within this sector increased at an annual rate of 3,96 %. Food production increased at an annual rate of 4,41 %. During the same period the South African population grew at an annual rate of 2,36 % (Groenewald, 1971).

The less-developed sector is found largely in the Black national states. In these areas agriculture has remained static for a long time and food production has lagged behind population growth. In many cases production techniques did not keep pace with modern trends. The result is that these areas are less and less able to feed their populations. Whereas the challenge in developed agriculture lies in adapting to changed economic conditions, the challenge in the less-developed sector lies in entering a period of increased productivity.

Unfortunately in many countries, including South Africa, there is large-scale fragmentation in approaches to the food system. This fragmentation is of both a disciplinary and an organisational nature. It comes to the fore in training, government services and organisation in general.

At university level, in view of the necessity for better liaison in the food industry, it would be sensible for many universities to follow the example of McGill University in Canada. There both agricultural and food sciences are handled by one university college. In addition to degree courses in agricultural sciences, degree courses are offered in the following: consumer services, nutrition, food science and hospitality management (McGill University, 1975).

In certain major fields one finds considerable interchanging of courses between students in agriculture and in food sciences.

3. PROBLEMS WITHIN THE FOOD SYSTEM

3.1 Increased gap between farmer and consumer

The food processing industry in South Africa is large relative to the size of the economy. In 1977, factory plants in South Africa supplied products to the value of approximately R24 000 million. Food processing industries supplied products to the value of R5 200 million, i.e. approximately 22 % of the total. The total output of other industries processing agricultural products was approximately R3 900 million, or approximately 16 % (Department of Statistics, 1978).

It goes without saying that the more services and the more processing involved in food supply and distribution the smaller the part of the eventual consumer price constituted by the farmer's

remuneration. Increasing services and processing of foods are characteristics of a progressive economy and this brings about an increased gap between the farmer and the consumer. It has been calculated that the monthly expenditure on food by the average White family rose by 42 % between January 1974 and May 1977. The farm value of the same products rose by 30 % during the same period. The increase in farmers' gross incomes was therefore less than the increase in consumer expenditure on food. Whereas the farmers' share dropped (during the same period) from 55 % to 50 %, the share of the gross distribution margin rose from 45 % to 50 % (Anonymous, 1977). The agricultural producer's share naturally differs from product to product, depending on the number and nature of the marketing functions involved. This increased gap is a factor contributing to economic instability in the farming industry.

Instability in the farming sector clearly has important effects throughout the economy and on a country's food system. On the one hand it is a factor which contributes to the migration of human material out of agriculture. Uncertainty regarding income also leads to suboptimal utilisation of resources. Eventually this also has an important effect on utilisation of capacity and therefore on unit costs in the processing and distribution of food products.

3.2 Problems in primary production

The major reason why agriculture in developed parts of the world has been able to increase per capita food production has been improved technology - increased yield per unit of inputs. In South Africa, yields per primary input unit (Groenewald, 1964), per unit of labour (Brand & Tomlinson, 1966) and per unit of capital (Brand, 1969) have increased. The technology has been mostly labour or land saving (Sawada, 1974; Ruttan, 1974; Heady, 1949; Sen, 1974; Hayami & Ruttan, 1971; Kaneda, 1969; Griliches, 1971). This tendency limits the per capita income-earning potential within agriculture. Fewer people are needed to cope with the primary production of more food. This is also reflected in the number of persons economically active in agriculture.

From figures available from the Department of Statistics it appears that the number of persons economically active in the White South African agricultural sector decreased by the following annual rates between 1963 and 1977:

Whites	2,6 %
Coloureds	2,4 %
Asians	5,5 %
Blacks	2,2 %

Most foodstuffs show a low elasticity of demand. This means that slight differences in quantities bring about major fluctuations in prices. Tweenen and Plaxico (1964) put it as follows: "A

low price elasticity means that consumers place a high value on having enough of a good and very little on having more." The elasticity of demand for food in South Africa is calculated at approximately -0.3 (Döckel & Groenewald, 1970).

This instability in prices is more serious at the primary production point than at the point of consumption. This is largely the result of the increased gap between the primary producer and the consumer. For example, if the farm share of the consumer price of a product is 90%, a 10% change in the consumer price brings about an 11% change in the primary producer price. If the farm share is 50%, the effect of a 10% change in consumer price at farm level is 20%.

Price instability, together with production instability caused by natural conditions (weather, pest epidemics, etc.), makes farm management difficult. This also leads to problems in the ability of agriculture to make its contribution to and have its rightful share in economic development. On the other hand prices for purchased farming inputs tend to remain high irrespective of the general economic climate. This factor in particular could delay development in agriculture in less-developed areas. Potentially it has important economic, social and political implications.

The availability of minerals could cause a problem in food production in the foreseeable future. For decades Western technology has been based to an ever-increasing extent on the use of mineral products. This has also been the case in agriculture. Increased numbers of metal implements have been used with increased quantities of fuel and chemicals of mineral origin. In the past fuel prices rose relatively more slowly than prices of other inputs and prices of most farm products. Since 1974 the situation has changed drastically. Fuel prices have begun to rise extremely rapidly.

To a certain extent this has shaken man out of his torpor. There are the warnings by Meadows *et al.* (1972) that the world's mineral resources are being used at such a rate that they may be exhausted early in the 21st century. Pollution problems are worsening the situation.

There has already been a great deal of discussion about the Meadows Report - especially regarding the realism of the depletion rates. It is, however, indisputable that a very real danger has been identified. All production, including food production, will have to become gradually less mineral intensive. This, in turn, will call for the development of new technology, supported by research on a scale unheard of to date.

A change-over to such new technology can only take place gradually. Probably cost increases, compared with present cost levels, will be involved. As a result, increasing economic pressure on the farming sector can be expected. Increases in food production may take place more gradually. Cost of food may show relative increases. This could adversely affect nutritional levels.

3.3 Competitive structure

Within the food processing and distribution sectors there is a worldwide trend towards greater concentration; fewer and fewer firms are controlling a larger and larger share of these industries. Such situations are not necessarily undesirable. There are cases where there are considerable economies of scale, and it has been shown that in such a situation a few large firms can compete very successfully with each other in their pursuit of differential advantage (Alderson, 1957, pp. 101-129).

Such developments, however, have the inherent danger that monopolies may develop. Economic theory shows that in order to achieve a maximum profit a monopolist produces less of a product at a higher price than would be the case if there was keener competition. In this way economic efficiency is sacrificed.

In a Canadian survey Macartney and Montigaud (1972, pp. 74-76) found clear indications that in highly concentrated food industries monopoly prices and profits were rampant. Long-term effects are even more harmful. In the absence of competition there are few incentives to increase productivity. Eventually both consumers and primary producers suffer. It is therefore no wonder that certain writers (*inter alia* Perkins, 1973 and Tweeten, 1969) have identified the competitive structure in the food industry as the most serious long-term problem for agriculture and food provision.

3.4 Food adulteration

Some of the new developments in food processing have not been in the interests of the consumer, especially from a health point of view. Frequently new products are not properly tested for nutritive value and their effects on health before they are sold to the general public. Sometimes products are only taken off the market long after harmful effects have been proved. The best known example is probably the artificial sweetener sodium cyclamate.

Food processing also sometimes goes hand in hand with a drop in nutritional value, apparently especially a drop in vitamins. This is the case, for example, with certain pre-cooked breakfast cereals (Turner, 1970, p. 85).

The examples mentioned above are all overseas examples. South Africa could undoubtedly supply its own quota of similar examples. Many food processors are subsidiaries of multi-national corporations, or receive technology (sometimes under licence) from overseas firms. There is also no reason to believe that South African control over such malpractices is any better than control in the USA, Canada or Britain. Our skilled manpower is inadequate for such confidence.

Recent measures prohibiting the addition of many synthetic substances are a step in the right direction, however.

3.5 Communication

A fragmented food industry creates communication problems. The importance of proper communication to the efficient functioning of any system has already been emphasised by many writers. It is essential for proper decision-making (Murdick & Ross, 1975, p. 10 and Alderson, 1957, p. 90). Stanton (1971, p. 496) claims that ... "in any society, the nature of interpersonal relations depends in large measure upon the effectiveness of interpersonal communication".

In the food chain everyone needs knowledge which must be communicated to them. Consumers need information concerning the availability, nature, quality and price of products. Producers and dealers need information on consumption trends, production tendencies, technology, etc. Like processors and dealers, farmers have to adapt their businesses. They need knowledge not only about current technology and prices but also about potential changes in these. Two-way communication is necessary. Continuous and adequate feedback are essential to good communication (Pistorius, 1972 and McCarthy, 1964, pp. 641-642).

The more fragmented a system is the more difficult meaningful two-way communication becomes. This is in fact a problem in the food system. Consumer services, services for dealers, services for industrialists and extension services for farmers are undertaken by different organisations.

To be effective, information must be adequate and correct. Information is inadequate if in essence it does not have the required factual content or if it does not reach the right audience to a sufficient extent.

4. FUTURE ACTION

The problems in the food system constitute a challenge to all interested parties. All scientists - both natural scientists and social scientists - in the food system have an important task. For the sake of convenience the challenge may be subdivided.

4.1 Better communication

Gaps in communication between the subsectors in the food system must be bridged. Gaps in communication between different scientists must also be bridged. Agriculturists ought to be made aware of problems experienced and opportunities created by food technologists, dieticians, food sociologists and food economists. There ought to be communication in the opposite direction as well. The commercial production of high lysine maize will be possible in the near future. Are consumers, dieticians, food technologists, etc. prepared for such a development? Will such production be economically significant? The agriculturist is waiting for answers to these questions. South Africa cannot afford to experience

the same setback resulting from the unacceptability of a new product which looks superior to the agriculturist as was experienced in parts of India with new rice cultivars (Farmer *et al.* 1977).

An institutional framework for better communication must be developed. To me it seems increasingly sensible for agriculturists and nutritionists to realise their interdependence and to forge institutional bonds with one another.

4.2 Government policy

There is neither the time nor the space to analyse or discuss government policy regarding agriculture in depth in this paper. However, it is so obvious that government plays an important role that this aspect cannot be overlooked. Only a few relevant points will be touched on here.

In the first place an attempt should be made to introduce a more integrated policy in respect of all facets of the agriculture and food sectors, and also in respect of different products. Rapid changes in the world economy and the local economy make this increasingly important. Mayer & Seavers (1974) put it as follows: "There is (now) far less slack in the economic system, farm and nonfarm. Food policy must be formulated under conditions with far more widespread consequences for every decision, and each decision interacts with almost all others. The commodity-by-commodity approach that has often dominated operational policy analysis over the decades is being questioned as excess production capacity and abundant inventories of farm products disappear. Today a far more comprehensive approach is necessary to reflect the increased complexity of food policy."

Regulatory services by the authorities play an important role. Standardisation of grades and other important characteristics of food and proper inspection are important and are carried out effectively in some cases. But there are still shortcomings and these become greater the closer one gets to the consumer. For example, beef from a correctly graded prime carcass is not necessarily really high quality meat if it reaches the consumer before the carcass has had a chance to overcome *rigor mortis* or if the carcass has been mistreated in certain other ways. But grading and grade inspections only take place before the product moves to the wholesalers and retailers.

To bring about the smooth functioning of the food system it will also be necessary to restrict monopolistic tendencies in the food distribution and processing industries, without killing initiative. In my opinion there is still much to be done in this regard in South Africa.

Certain malpractices in the food retail market must also be combated by legislation.

The most important common malpractices in Canada are double price tags, absence of stocks when special offers are advertised, practices within the store aimed at misleading clients and multiplication of sizes (Anon., 1973). In South Africa steps have been taken against the

first-mentioned malpractice but the others should receive more attention. The diversity of sizes, in particular, is a problem in South Africa.

Product testing for safety is also important. In South Africa there is room for an organisation similar to the American Food and Drug Administration - provided it functions more effectively than the American body.

Finally, more attention will have to be given to labelling - as regards both correctness and completeness. It should *inter alia* be compulsory to mention additives.

4.3 Co-operation between disciplines

In conclusion it is perhaps as well to repeat my plea for a rapprochement between nutritionists and agriculturists. After all, the two groups are working with the same biological product. Their final goal is the same: better nutrition of the community and proper compensation for everyone in the food system. Their fields of interest are similar, although they concentrate on different facets. Their basic scientific background is more or less the same. Their spheres overlap.

REFERENCES

- ANON. (1977) Margin between farm and consumer prices of food, based on a South African food basket. *Crops and markets* 56(622): 1-12.
- ANON. (1973) *Report on the survey of retail food stores*. Ottawa: Food Prices Review Board.
- ALDERSON, Wroe (1957) *Marketing behaviour and executive action*. Homewood: Richard D. Irwin.
- BRAND, S.S. (1969) *The contributions of agriculture to the economic development of South Africa since 1910*. D.Sc (Agric.) thesis, University of Pretoria.
- BRAND, S.S. & Tomlinson, F.R. (1966) Die plek van die landbou in die Suid-Afrikaanse volkshuishouding. *S.A.J. Econ.* 34: 26-49.
- Department of Statistics (1978): unpublished figures.
- DÖCKEL, J.A. & GROENEWALD, J.A. (1970) The demand for food in South Africa. *Agrekon* 9(4): 15-20.
- FARMER, B.H. *et al.* (1977) *Green revolution?* London: Macmillan.
- GRILICHES, Zvi (1971) The sources of measured productivity growth: United States agriculture, 1940-1960. In: Rosenberg, N. (Ed) *The economics of technological change*. Baltimore: Penguin Books.
- GROENEWALD, J.A. (1970) South African agriculture: Development and policy implications. *Human Sciences Journal*, 10: 167-179.
- GROENEWALD, J.A. (1971) The state of South African agriculture. A diagnosis. *Agrekon* 10(1): 12-26.
- GROENEWALD, J.A. (1977) Trends in farm products and requisites. *Symposium on farm financial management*. Pietermaritzburg: South African Institute of Agricultural Extension, Natal Branch.
- GROENEWALD, J.A. (1964) Changes in primary sources in South African agriculture. *Agrekon* 3(3): 22-29.
- HAYAMI, Y. & RUTTAN, Vernon W. (1971) *Agricultural development. An international perspective*. Baltimore: Johns Hopkins Press.
- HEADY, Earl O. (1949) Basic economic and welfare aspects of farm technological advance. *J. Farm. Econ.* 31: 293-316.
- KANEDA, H. (1969) Economic implications of the green revolution and the strategy of agricultural development in West Pakistan. *Pakistan Development Review* 9: 111-143.
- LEFTWICH, Richard H. (1970) *The price systems and resource allocation*. Fourth Edition. Hinsdale: Dryden Press.
- MACARTNEY, L.K. & MONTIGAUD, J.C. (1972) *Preliminary report on the institutional structure of the Canadian agriculture and food system*. Ottawa: Agricultural Economics Research Council of Canada.
- MAYER, Jean (1976) The dimensions of human hunger. In: Wortman, S. *et al. Food and agriculture*. San Francisco: W.H. Freeman & Company.
- MAYER, Loe V. & SEEVERS, Gary L. (1974) Food policy issues in the United States. *Amer. J. Agr. Econ.* 56: 359-393.
- McCARTHY, E. Jerome (1964) *Basic marketing. Revised Edition*. Homewood: Richard D. Irwin.
- McGill University (1975) *Announcement: Faculty of Agriculture, School of Food Science, 1975-76*.
- MEADOWS, Donella H.; MEADOWS, Dennis L.; RANDERS, JORGEN & BEHRENS, William, W. III (1972) *The limits to growth*. New York: New American Library.
- MOSHER, A.T. (1971) *To create a modern agriculture*. New York: Agricultural Development Council.
- MURDICK, R.G. & ROSS, J.E. (1975) *Information systems for modern management. Second Edition*. Englewood Cliffs: Prentic-Hall.
- PERKINS, Brian B. (1973) Farm income and labor mobility. *Amer. J. Agr. Econ.* 55: 913-920.
- PISTORIUS, C.W.I. (1972) *Inligtingsbestuur*. Professorial inaugural lecture, University of Pretoria.
- POWER, Jonathan & HOLLENSTEIN, Anne-Marie (1976) *World of hunger*. London: Temple-Smith.
- ROLL, Eric (1950) *A history of economic thought*. New York: Prentice-Hall.
- RUSSETT, J. *et al.* (1964) *Handbook of political and social indicators*. New Haven: Yale University Press.
- RUTTAN, Vernon (1974) Induced technical and institutional change and the future of agriculture. *Papers & Reports, Fifteenth*

- Internat. Conf. Agr. Economists.* pp. 35-52
Oxford: Agricultural Economics Institute.
- SAWADA, S. (1974) Technological stages in agricultural developments. Their determinants and perspective. *Papers & Reports, Fifteenth Internat. Conf. Agr. Economists.* pp. 253-261.
Oxford: Agricultural Economics Institute.
- SEN, A.K. (1974) The future of agriculture. *Papers & Reports, Fifteenth Internat. Conf. Agr. Economists.* pp. 4-16. Oxford: Agricultural Economics Institute.
- STANTON, William T. (1971) *Fundamentals of marketing.* Third Edition. Tokyo: McGraw-Hill Kogakusha.
- TURNER, James S. (1970) *The chemical feast.*
New York: Grossman Publishers.
- TWEETEN, Luther G. (1969) Theories explaining the persistence of low resource returns in a growing farm economy. *Amer. J. Agr. Econ.* 51: 789-817.
- TWEETEN, Luther G. & PLAXICO, James (1964) U.S. policies for food and agriculture in an unstable world. *Amer. J. Agr. Econ.* 56: 364-371.