General Comment 4
Relation Between Postharvest Technologies and Economic Development

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The interpretation of the term postharvest technologies (PHTs hereinafter) varies among the researchers because it can cover by nature all the "technologies" involved in lengthy chains of human activities from harvested fields to consumers. PHTS may include a wide range of scientific methods, knowledge and skills required for the processing, marketing and control of the materials and food products that flow in these chains. PHTs are influenced by many factors such as the kinds of users, commodities involved, consumers' demand, available infrastructure and so on. For this reason, discussions on PHTs tend to be diffuse.

This symposium is no exception. Some speakers emphasized the improvement of paddy drying technologies while others called for advanced technologies for food irradiation or controlled atmosphere package. A few speakers referred to specific technologies for processing few export products. The need for a better infrastructure and training was also stressed.

However, the various discussions may be realigned along economic viewpoints since the factors influencing PHTs seem to be related to the economic conditions of the country where the technologies apply.

1 Factors influencing PHTs

First, there is a correlation between economic development and food consumption pattern. Fig. 1 illustrates the relation of GDP to the consumption of two major food groups, i.e. starchy foods and others (mainly animal products). History shows that as income per capita increases, consumption of starchy food declines and that of animal products rises. It is assumed that PHTs in a country should reflect this trend due to the consumer demand at each stage.

Fig. 2 depicts another dimension of the relation. As the economy develops, the value-added from agriculture as a percentage of total final consumption of food quickly declines. Consumers in richer countries pay more for the values of non-agricultural origin, including the cost for storage, processing, marketing and catering than for the cost of agricultural products themselves. We assume that the size of each cost component would reflect the type and sophistication of the PHTs to be used.

Fig. 3 highlights the relation between economic development and investments in infrastructure and human capital. In less developed nations, infrastructure such as roads, power, water supply, educated labor is insufficient both in volume and quality. Their PHTs must be severely constrained by the poor infrastructure. Advanced large-scale processing technologies may not be applicable unless a stable supply of electricity and water or well-trained technicians is guaranteed. Frozen food cannot be sold in mass if nationwide networks of transportation and cold storage chains are poorly developed.

There may be some other important factors influencing PHTs in a country. Industrial structure including that of agriculture may be one of them. If producers on a small scale prevail in the farm sector or processing sector, large-scale PHTs that require high capital investment would have little relevance. Areas of consumption also have a big impact. If a country produces certain farm products for export, then PHTs may be specific to those commodities and adopt higher standards to meet the demand from importing countries. We may not be able to overlook climatic factors. Technologies to dry, fumigate or preserve products become more important in humid tropical Asia. Attention should be paid to these non-economic factors because they may cause specific countries to deviate from the basic correlation lines stated above.

Obviously there are many PHTs which do not change very much with economic development. Basic fermentation technologies for soybean products may not differ appreciably between Indonesia, China and Japan. Main sets of technologies that small producers use in preserved food look more or less the same in Asian countries: drying, heating, salting, or fermentation. In these cases too, however, economic development exerts a considerable impact on the technologies. In richer countries, mechanical, electrical, chemical power is the main driving force while human labor and natural resources are the main ones in less developed countries.

2 PHTs corresponding to economic development

By putting these relations together, we may outline the basic nature of PHTs that become more complex along with economic development. As shown in Fig. 4, PHTs must be more agriculture-oriented and grain-oriented at the early stages of economic development. Main users of the technologies are small farmers, their groups and small enterprises in local villages. PHT chains at this stage are short and simple because the products are largely consumed by producers and local residents. Typical PHTs in this case are associated with drying or milling of rice.

In well-developed countries, PHTs become more business- or consumer-oriented. Many kinds of products are processed and mixed with each other. Main users of PHTs are big enterprises that can afford large factories and an educated labor force. There are many large food companies that produce and market numerous processed food items throughout the world. Technologies are more sophisticated and systematized in complicated sequences. They pay particular attention to health and sanitary concerns, consumer's taste, convenience, etc.

PHTs in many Asian countries stand in the middle. Various agricultural products are processed, marketed but mostly by small producers/traders with less sophisticated technologies. Small numbers of big enterprises apply advanced technologies in their factories or storage facilities very often for exports. The diffusion of refrigerators and electronic ovens among urban households is offering increasing markets for frozen products whereas rural households still rely on fresh or dry products.

Most speakers in our symposium outlined their priority areas and policies for PHTs in their countries, which seem to be largely in line with the notions we have described above. For example, speakers from Vietnam, the Philippines and India focused on the technologies for their staples especially rice. They echoed the need for better milling and storage technol-

ogy as a means to reduce postharvest losses and broken contents. Improved rural infrastructure and farmers' training were emphasized as well. On the other hand, the presentations made by the Taiwanese and Korean speakers touched upon the advanced technologies that reflected the diversified and quality-oriented food demand in their countries and export markets. Speakers from Thailand and P. R. China referred to the need for better standards or marketing regulations for grains and processed food. Improved storage and marketing facilities were also stressed for reducing losses and maintaining a better quality.

3 Priorities for JIRCAS collaborative research

With its limited resources, JIRCAS can not meet all the demands from Asian countries for research collaboration in PHTs. For these reasons, I would like to suggest that JIRCAS should focus its activities on the low-cost, environment-friendly technologies for drying (dehydration), storage and fermentation targeted to small producers or their groups. It may also be desirable to develop technologies to produce protein-rich processed products by using cheap materials such as soybeans, freshwater fish and their wastes.

First, JIRCAS should refrain from moving to the area where the private sector and big enterprises are more active. They may be willing to develop and apply advanced PHTs in developing countries if business opportunities are given. JIRCAS has little comparative advantage in the large-scale food-manufacturing technologies or in modern POP marketing system.

Second, in its charter, JIRCAS is committed to the promotion of sustainable agricultural development compatible with the preservation of the environment. We are convinced that the development of low-cost drying technologies utilizing natural power such as sunlight and heat or wind may be worth considering. Fermentation technologies are more amenable to the environment than other food-processing technologies.

Third, technologies for drying, fermentation and storage have wider applications in Asia. They are the most common elements in all the postharvest activities in the region. Harvested paddy, maize and legumes need quick drying before erratic rains come. Fermentation technologies are applied for the production of tempe, natto, soy sauce, fish sauce, kimchi, tsukemono, yogurt, cheese and local rice wine. Safe and low-cost storage is indispensable for most agricultural products in hot and humid Asia. Fourth, increased supply of low-price protein products in Asia is urgently needed because of the rapid shift in dietary patterns. Technologies to produce durable, tasty fish cakes from freshwater fish or imitation meat from vegetable protein or cheap marine organisms may prevent possible price hike in animal products.

Food scientists in JIRCAS alone, however, can not perform these tasks. Close cooperation with agronomists, economists and other scientists must be maintained. JIRCAS will strengthen further collaboration with many partners in and outside Japan. Assistance from the research institutes affiliated to MAFF, overseas counterpart institutes, international research centers and the private sector are a prerequisite for successful research on PHTs.

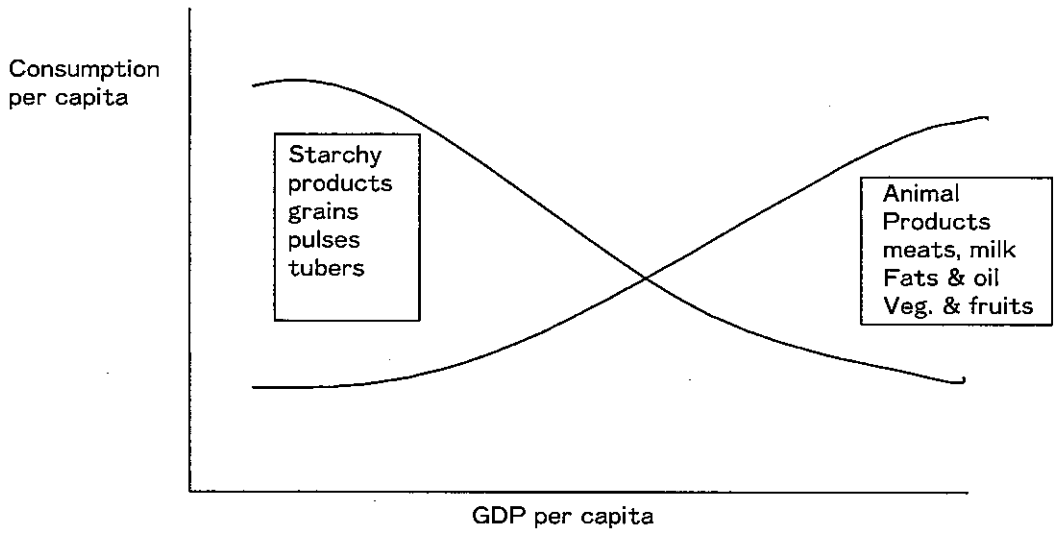

Fig. 1 Relation between composition of food intake and economic development

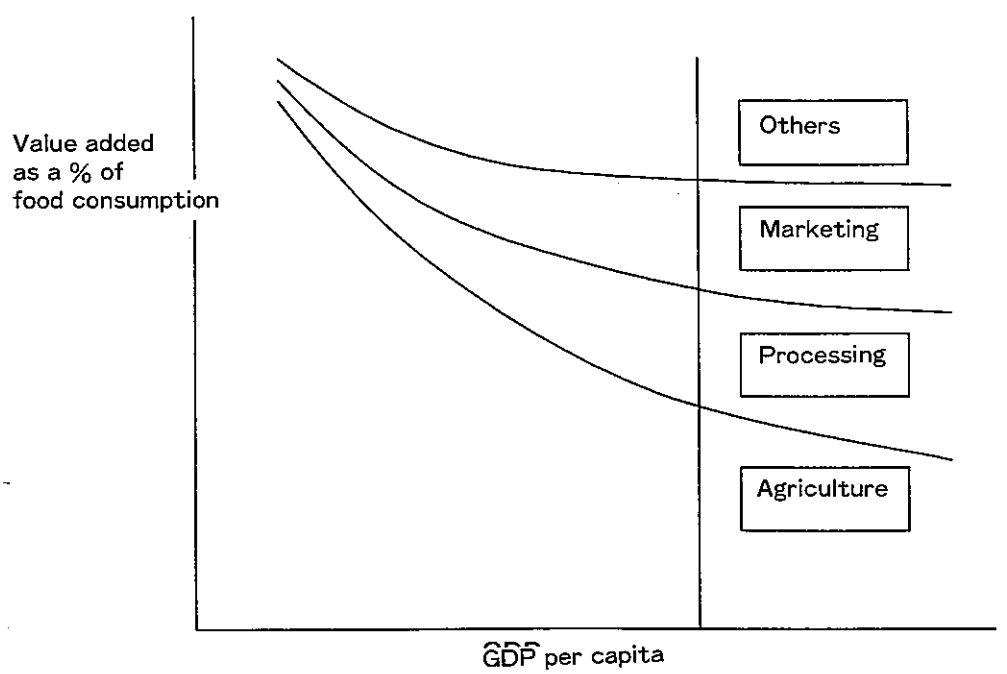

Fig. 2 Share of agriculture as a percentage of final food consumption

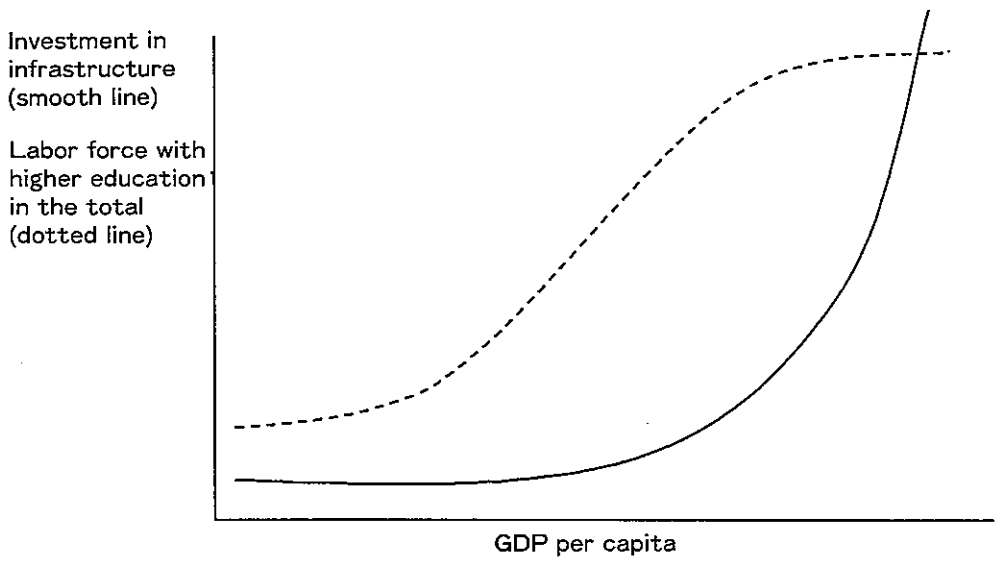

Fig. 3 Infrastructure and economic development

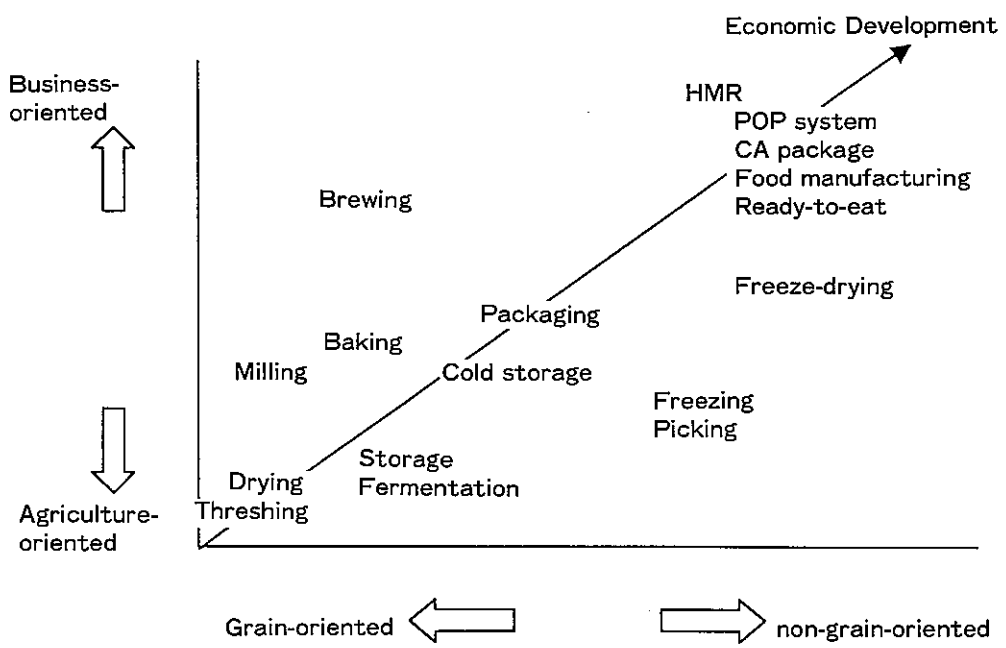

Fig. 4 Relation between PHTs and economic development