INTRODUCTION TO POTATO STORAGE

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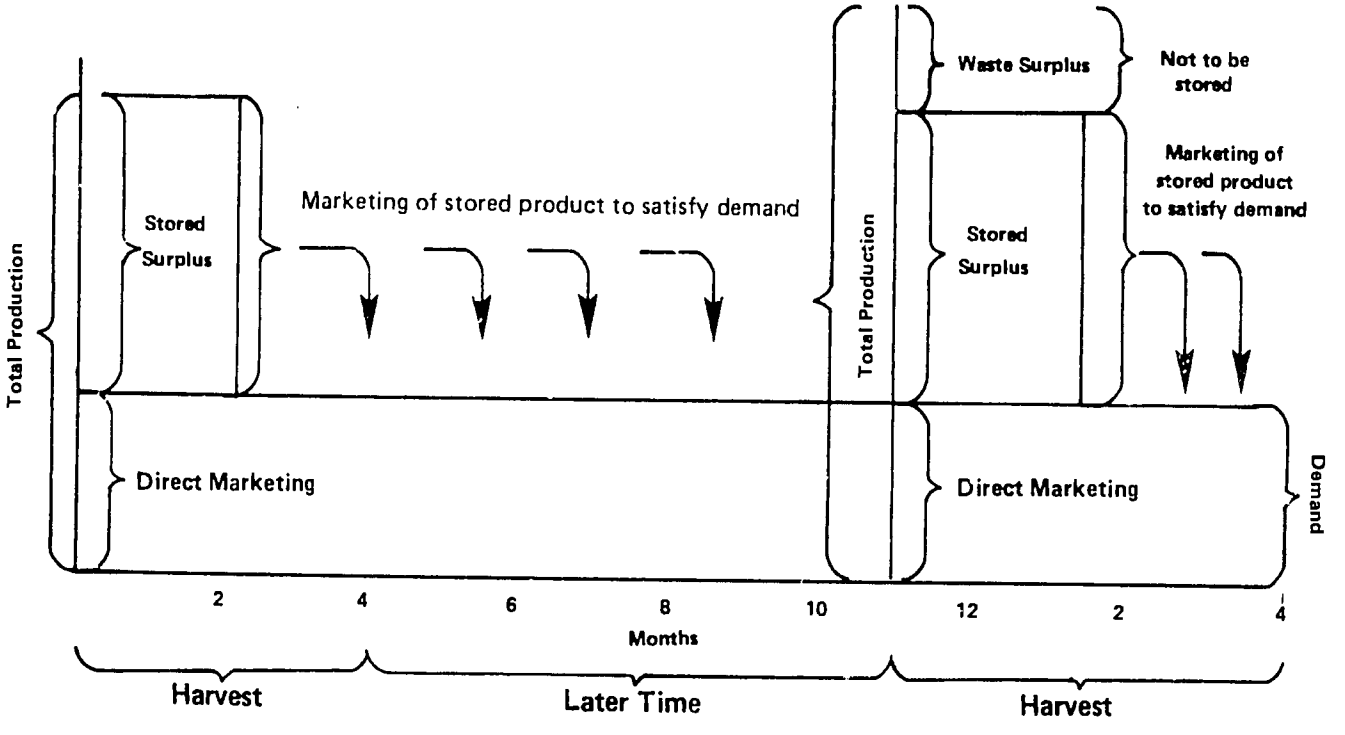
Function of Potato Storage

Potato production aims at sufficient supply of potatoes for total market demand. This can be achieved by two means

- continuous, market oriented production, or
- periodic production and storage

because continuous production is rarely practicable in all regions, storage is commonly necessary. Potatoes surplus to market demand at harvest time must be stored to be available for market demand at a later time (Figure 1). Market demand is commonly almost constant. (The demand will increase slightly with lower prices and decrease slightly when prices are increased.) Therefore, the function of storage is to move potatoes, in a controlled fashion, through time.

Figure 1. The Storage Reservoir



At harvest time the farmer is busy harvesting potatoes and other crops. The farmer lacks the time to look for a better market or negotiate a better price. With a storage available, the farmer has the option of selling or of placing potatoes in the storage to be sold later. This helps prevent wide price fluctuations.

Additionally, seed potatoes for planting the next crop must always be stored until planting time.

The System

Without storage the system is Production ⟶ Demand. With storage the system becomes

Storage is a reservoir. As part of the system it holds the surplus production potatoes and releases them as needed by market demand. However, much of the production goes directly to market without going into the storage reservoir. Only the surplus goes into the storage.

Storage <u>must</u> fit into this system. It must be acceptable to the producers and it must be acceptable to the market. If it does not fit into the system it will not be used properly and will not perform its function of making potatoes available at a later date. Detailed information on production pattern, marketing system and consumer demand patterns will influence both the duration of storage required and the magnitude of the facilities needed.

The storage reservoir must give a stable supply/price to market demand. For this reason we must understand market demand. We must know what varieties and what quality is demanded by the market. Then, only those varieties and that qualily must be stored.

We must also know what other systems of production-storage in other production zones are supplying the market.

MOST IMPORTANT OF ALL, WE MUST KNOW HOW MANY POTATOES ARE DEMANDED BY THE MARKET. OVERSUPPLY MEANS A DECREASE IN PRICES. WE MUST KNOW TO WHAT EXTENT OVERSUPPLY ON UNDERSUPPLY INFLUENCES PRICES AND DEMAND.

With this information the flow of potatoes from storage to market can be controlled so as to obtain the best prices and pay the cost of storage.

Storage costs money. Therefore, storage adds to cost of potatoes. Stored potatoes always cost more than fresh potatoes. But the increased consumption of potatoes because of the more stable supply/price may justify the added cost. Also, the farmer will benefit by the option of selling, or not selling.

The Storage Climate

The storage climate is the interior climate of the store and the exterior climate of the store.

The exterior climate is the natural climate at the location of the storage building. It involves wind, rain, humidity, hours of sun, maximum daily temperature, minimum daily temperature, and number of hours per day that the temperature is below a certain level (usually 10°C). This information is needed for those months the potatoes are to be stored.

The interior climate is the climate desired for the potatoes during the length of time and for the purpose for which they are stored. Interior climate is used mainly to control the quality of the potatoes, to reduce sprouting, to keep weight loss at a minimum, to retard the spread of storage diseases, and to remove the heat of respiration of potatoes.

Interior climate can be controlled by one or a combination of several methods:

(a) Natural ventilation which is a simple use of exterior climate during certain hours.

(b) Forced ventilation in which the exterior climate is forced, by fans, through the potatoes during specific hours.

(c) Forced ventilation with humidification in which water vapor is added to the forced air of (b).

(d) Mechanical refrigeration in which the interior climate is air conditioned.

To properly select the optimum method we must know the thermodynamic properties of the exterior climate and of the desired interior climate.

The properties are:

1. Wet Bulb Temperature
2. Dry Bulb Temperature
3. Humidity (Relative)
4. Specific volume
5. Heat Content
6. Humidity (Absolute)

If we know any two (usually the easily measured dry bulb and wet bulb temperatures) the other thermodynamic properties can be easily determined from a psychrometric chart.

Economic

Storage requires investment, and even if the storage is used only partially (or not at all) it adds to the cost of the system of production-storage-demand. The more complicated the storage, the higher the investment. Therefore, the most cost effective storage possible must be applied.

The price of potatoes invariably increases with time after harvest. But this increase may or may not compensate for the storage investment costs. Storage of potatoes does not guarantee a profit; storage merely gives the farmer a chance to try for a higher profit, if desired.

Observations of price trends during the year and the supply/price relationship of the market, are essential for the economic management of the storage part of the system (Figure 2).

Without storage, price at harvest may be below production cost and may be very high later in the year.

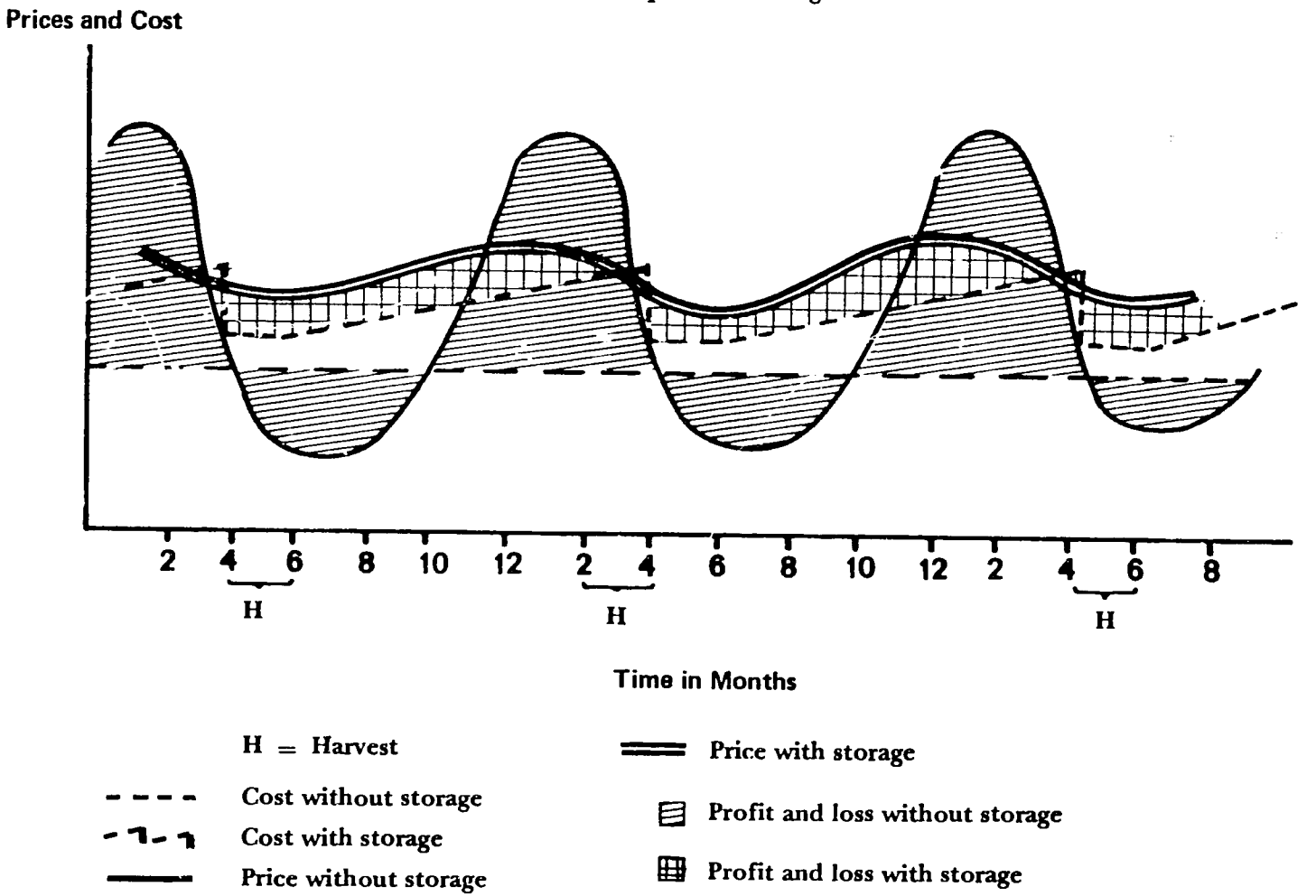
With storage, price at harvest need not be below production cost. But because there are potatoes in store that can be sold, the price will not go as high as when storage is not available.

Do not use the historical price of potatoes without storage to predict prices with storage or to forecast the potential profit of using potato stores.

Seed Storage - Special Considerations

Conditions of seed storage influence the physiological aging processes of tubers which affect subsequent perfomance of the crop with respect

Figure 2. Economic Aspects of Storage



to earliness and yield. Optimum development of sprouts is greatly influenced by the apical dominance of the tuber. Both processes can be controlled by temperature management. Where adequate control of storage temperature is not possible, sprout growth may be controlled with the use of light. In simple stores relying on natural convective ventilation, light can be used to compensate for the effects of above optimum storage temperatures.

Storage Management

Storage management is as critical to the system as is production management and marketing skills. Operation of the storage reservoir must be carried through thoroughly. Without proper storage management the system becomes inefficient and costly.

Even with optimum technical facilities, store only good quality tubers. Strive to produce potatoes of high storage quality. Potato varieties show considerable differences in important storage characteristics. However, storage behavior depends also on growing conditions. Conditions for high yield, and for food storage characteristics may be contradictory. For example:

- high N fertility increases yield
- but decreases storage quality

Selection of growing site and land preparation help define storage quality of harvested tubers. Inadequately selected and prepared fields imply subsequent difficulties in proper cultivation and harvest practices. These again cause mechanical and pathological damages resulting in lowered storage quality of tubers.

Because many storage losses are the result of what takes place during the growing season, proper management of these pre-storage factors together with rigorous selection can prevent storage losses.

Three types of losses during storage are:

Pathological losses by microorganisms, insects and animals are serious. Quantitative damages are caused by organisms which destroy the tuber tissue (*Phytophthora infestans*, *Erwinia* spp., etc.). Qualitative damages influence external appearance (*Helminthosporium solani*, *Rhizoctoni solani*). The most damaging insect is the potato tuber moth. Construction of storage should prevent entrance of rodents.

Disease and insect infections occur in the field, through handling, or during storage. Most fungal pathogens are wound parasites which do not infect through undamaged or cured tuber skin. Therefore, skin maturing and wound curing prior to storage are important. Chemical pesticides may be used to reduce losses during the storage of seed potatoes but in most cases chemical residues restrict their application to potatoes for consumption.

Physiological loss caused by the bilogical processes in the potato. The living tubers use some of their carbohydrates for support. During this process heat is produced. When sprouting occurs the rate of these processes increases several times. Proper use of sprout inhibitors reduce these losses. In the case of seed potatoes, light can be used to reduce sprout growth.

The nearer the storage temperature is to 5°C, the slower are most of the biochemical processes and losses, in turn, are lower.

Evaporation loss caused by the Vapor Pressure Deficit (VPD) between vapor pressure of water in air and vapor pressure of water in the potato. The vapor pressure of water in the storage air is determined by the temperature

and the relative humidity of the air. When the VPD is less than 2 millibars, potatoes will keep satisfactorily for 3 to 4 months. Therefore, keep the relative humidity as high as possible. This is easy to do when air temperature is about 7°C.

These three types of losses are always greater on damaged, diseased or immature potatoes. Therefore, carefully select the potatoes that go into storage. This is the most critical factor in storage management.

Storage Building

We now know the quantity and quality of potatoes to be stored, why they are to be stored, for how long to store them and the interior and exterior climates.

We must also know how to:

- select and construct and appropriate storage reservoir, and
- manage the store so that storage losses are minimal and that potatoes of good quality are supplied as needed to the market.

Any storage system, no matter how simple, costs money. The system selected should be that which yields greatest returns on the investment available, which may or may not be the same as the technically best system. The selected system is, therefore, frequently a compromise between technical requirements and socio-economic constraints.

Technical considerations in the selection and construction of storage facilities include: size of individual units, local availability/costs of building and insulating materials and electricity, duration of storage required, and local environmental conditions of temperature and relative humidity. Socio-economic constraints include: level of financial investment available, stability of the demand pattern which greatly influences the degree of risk, and availability of managerially and technically competent manpower.

The size of the storage unit should be large enough to handle the amount of a single potato variety that is harvested and prepared for storage in one week. There can be one or more storage units in each storage building.

Materials for construction will generally be those that are locally available at low cost. Each storage unit has to be designed and arranged so that the potatoes can easily be placed in it and removed from it. Three major requirements of a structure used for potato storage are: weather protection, adequate insulation, and retention of the potatoes.

The greater the duration of the storage period required, the greater the control required over the storage atmosphere to keep losses to a minimum.