

# **INFRASTRUCTURE POLICIES FOR PRICE STABILISATION OF POTATO IN KARNATAKA**

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**SEPTEMBER, 2002**

# **INFRASTRUCTURE POLICIES FOR PRICE STABILISATION OF POTATO IN KARNATAKA**

*Thesis submitted to the  
University of Agricultural Sciences, Dharwad  
in partial fulfilment of the requirements for the  
Degree of*

*Doctor of Philosophy  
in  
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*By*  
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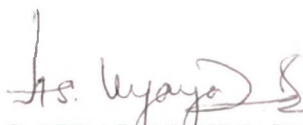
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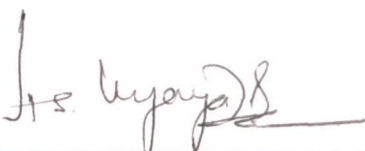
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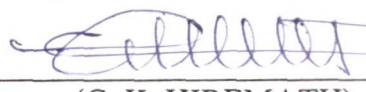
  
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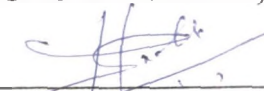
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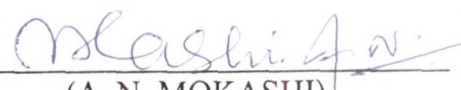
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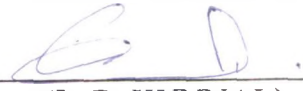
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**SEPTEMBER, 2002**

  
**(A. Josen Jose)**

## CONTENTS

| <b>Chapter No.</b> | <b>Title</b>                    | <b>Page No.</b> |
|--------------------|---------------------------------|-----------------|
| I.                 | INTRODUCTION                    | 1 - 15          |
| II.                | REVIEW OF LITERATURE            | 16 - 86         |
| III.               | METHODOLOGY                     | 87 - 115        |
| IV.                | RESULTS                         | 116 - 196       |
| V.                 | DISCUSSION                      | 197 - 230       |
| VI.                | SUMMARY AND POLICY IMPLICATIONS | 231 - 245       |
| VII.               | REFERENCES                      | 246 - 273       |
|                    | APPENDICES                      | 274 - 281       |

## LIST OF TABLES

| <b>Table No.</b> | <b>Title</b>                                                                         | <b>Page No.</b> |
|------------------|--------------------------------------------------------------------------------------|-----------------|
| 3.1              | Area and Production of potato in major districts of Karnataka for the year 1999-2000 | 89              |
| 3.2              | Nominal protection coefficient of Indian potato (Importable hypothesis)              | 107             |
| 3.3              | Nominal protection coefficient of Indian potato (Exportable hypothesis)              | 108             |
| 4.1              | Trend in Arrivals of Potato                                                          | 118             |
| 4.2              | Trend in prices of Potato                                                            | 119             |
| 4.3              | Trends in area, production and productivity of potato in Karnataka                   | 120             |
| 4.4              | Seasonal Indices in arrivals of Potato                                               | 122             |
| 4.5              | Seasonal indices in prices of potato                                                 | 124             |
| 4.6              | Correlation coefficients of prices of potato in selected markets of Karnataka        | 127             |
| 4.7              | Constraints in production of uniform grades/ quality of potato                       | 129             |
| 4.8              | Reasons for not producing uniform size of produce                                    | 131             |
| 4.9              | Farmers opinion about availability of infrastructure facilities at APMCs             | 133             |
| 4.10             | Farmers opinion on transaction facilities at selected APMCs                          | 135             |
| 4.11             | Farmers reasons for selling potato through commission agents                         | 137             |
| 4.12             | Profile of cold storage units in Karnataka                                           | 139             |
| 4.13             | Utilization pattern of storages by potato farmers                                    | 141             |
| 4.14             | Farmers behaviour in storing potato                                                  | 142             |
| 4.15             | Establishment cost of local storage structure                                        | 144             |

| Table No. | Title                                                                                                              | Page No. |
|-----------|--------------------------------------------------------------------------------------------------------------------|----------|
| 4.16      | Establishment cost of Cold storage structure                                                                       | 145      |
| 4.17      | Cost and returns in different storage structure for owners'                                                        | 147      |
| 4.18      | Annual cost calculation in storage structures                                                                      | 148      |
| 4.19      | Cash flows in cold storage structures running at 42 per cent capacity utilisation                                  | 150-151  |
| 4.20      | Cash flows in cold storage structures running at 50 per cent capacity utilisation                                  | 152-153  |
| 4.21      | Cash flows in cold storage structures running at 60 per cent capacity utilisation                                  | 154-155  |
| 4.22      | Cash flows in cold storage structures running at 70 per cent capacity utilisation                                  | 156-157  |
| 4.23      | Evaluation of investment in cold storage structure at various levels of capacity utilisation                       | 159      |
| 4.24      | Price difference of potato crop in Kharif and rabi season at different Months After Harvest (MAH)                  | 162      |
| 4.25      | Cash flows in local storage for potato stored for one month after harvest                                          | 164      |
| 4.26      | Cash flows in local storage for potato stored for two month after harvest                                          | 165      |
| 4.27      | Cash outflows and inflows in local storage for potato stored for three month after harvest                         | 166      |
| 4.28      | Evaluation of investment in local storage structure at subsequent months after harvest for rabi season potato crop | 168      |
| 4.29      | Cost of storage of potato in kharif season                                                                         | 170      |
| 4.30      | Cost of storage of potato in rabi season                                                                           | 172      |
| 4.31      | Cost of storage of potato in kharif season (Rs per qtl )                                                           | 174      |
| 4.32      | Cost of storage of potato in rabi season (Rs per qtl)                                                              | 176      |

| <b>Table No.</b> | <b>Title</b>                                                               | <b>Page No.</b> |
|------------------|----------------------------------------------------------------------------|-----------------|
| 4.33             | Net gains from potato stored in cold storages in Karnataka                 | 178             |
| 4.34             | Percentage distribution of buyers handling potato in Chikkaballapur market | 180             |
| 4.35             | Transitional probability matrix of Indian potato exports                   | 182             |
| 4.36             | Actual and estimated export shares of Indian potato to major importers     | 184             |
| 4.37             | Projected export share of Indian potato to major importing countries       | 186             |
| 4.38             | Nominal protection coefficient of Indian potato (Exportable hypothesis)    | 188             |
| 4.39             | Nominal protection coefficient of Indian potato (Importable hypothesis)    | 189             |
| 4.40             | Domestic resource cost ratio of potato                                     | 191             |
| 4.41             | Cost minimisation transportation model                                     | 194             |
| 4.42             | Profit maximisation transportation model                                   | 196             |

## LIST OF FIGURES

| Figure No. | Title                                                                         | Between pages |
|------------|-------------------------------------------------------------------------------|---------------|
| 3.1        | Map of Karnataka state showing agricultural zones                             | 87-88         |
| 4.1        | Seasonal indices of arrivals and prices of potato in Bangalore market         | 122-123       |
| 4.2        | Seasonal indices of arrivals and prices of potato in Belgaum market           | 122-123       |
| 4.3        | Seasonal indices of arrivals and prices of potato in Chikkaballapur market    | 122-123       |
| 4.4        | Seasonal indices of arrivals and prices of potato in Hassan market            | 122-123       |
| 4.5        | Seasonal indices of arrivals and prices of potato in Hubli market             | 122-123       |
| 4.6        | Seasonal indices of arrivals and prices of potato in Kolar market             | 122-123       |
| 4.7        | Cyclical variations in market arrivals of potato in Karnataka                 | 126-127       |
| 4.8        | Cyclical variations in market prices of potato in Karnataka                   | 126-127       |
| 4.9        | Cyclical variations in arrivals and prices in Bangalore market                | 126-127       |
| 4.10       | Cyclical variations in arrivals and prices in Belgaum market                  | 126-127       |
| 4.11       | Cyclical variations in arrivals and prices in Chikkaballapur market           | 126-127       |
| 4.12       | Cyclical variations in arrivals and prices in Hassan market                   | 126-127       |
| 4.13       | Cyclical variations in arrivals and prices in Hubli market                    | 126-127       |
| 4.14       | Cyclical variations in arrivals and prices in Kolar market                    | 126-127       |
| 4.15       | Lorenz curve showing concentration of potato traders in Chikkaballapur market | 180-181       |
| 4.16       | Actual and predicted share of potato export from India                        | 184-185       |

# *Introduction*

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# I. INTRODUCTION

Potato is an edible starchy tuber produced by certain plants of the Genus – *Solanum* and Family-Solanaceae. The common White potato (*Solanum tuberosum* L) is a plant native of the Peru-Bolivian region in the highlands of South America, where it has been consumed for more than 8000 years. The archaeological evidence of potato cultivation is afforded by ceramics from Northern coast of Peru belonging to 400 A.D of Moche, Chimu and Inca cultures. Potato was navigated to Europe in the 16<sup>th</sup> century by Spanish explorers as a botanical curiosity. It was introduced into Europe on two occasions, firstly into Spain in about 1570 A.D and secondly into England in 1590A.D through Spanish introduction and there after, it diffused throughout Europe and Asia. During the 19<sup>th</sup> century it had spread through out the European continent, providing cheap and abundant food for the workers of the Industrial Revolution.

The Portuguese introduced Potato in the early part of the 17<sup>th</sup> century. The first mention of potato in India, appears in Terry's account of the banquet at Ajmer, given by Asaph Chan to Sir Thomas Roe in 1615A.D.It is noticed that potato was existing in India even during 10<sup>th</sup> century as mentioned by Pickering (1879) in "Chronological History Of Plant", pp: 660-662. Initially, it was cultivated in Surat on the West coast, later it spread to other areas like Goa during the Portuguese regime. Goans called Potato as "Batata surrata" pointing towards the

likely introduction of Potato from Surat. With access to irrigation, chemical inputs such as fertilizers, continued expansion in post harvest infrastructure in the form of roads and cold storage facilities, producers continue to find potatoes an extremely attractive crop to grow. Strong demand both in the countryside and in rapidly growing urban areas continues to stimulate increases in area planted.

Today, potato is the 4<sup>th</sup> most important food crop in the world exceeded only by wheat, rice and maize for human consumption. Potato ranks fifth in area under cultivation, fourth in production tonnage and is cultivated in about 130 countries sustaining three-fourths of the world population. Some of the leading potato producing countries are China, Russian Federation, Ukraine, Poland, Belarus, US, Germany, Turkey and the Netherlands. India is the fourth largest potato producing country with a production of 25 million tonnes from 1.34 m ha. India's productivity of 18.6 MT/ha is higher than the world average of 16.4 MT/ha. In India potato is grown mainly in the Indo-Gangetic plains, consisting of the states like Punjab, Haryana, Uttar Pradesh, Bihar, West Bengal and the Union Territory of Delhi which is considered as the potato bowl of the country.

In most of the developed countries and in several developing countries in South America, potatoes enjoy the status of a staple food. But, it is still considered as a vegetable in Asia and Africa. A large portion of potato is consumed in processed form in developed countries whereas in the developing countries a small portion of potatoes is consumed in

processed form. This holds much promise for diversifying potato consumption in developing countries.

Potato is a wholesome and nutritious food. It seems somewhat paradoxical that in a developing country like India where the population continues to grow and the demand for food is increasing, potato has not yet been recognized as a food crop. Renowned agricultural scientist Dr M. S. Swaminathan wrote, "If India wishes to achieve food security, its agriculture has to produce more food from diminishing per capita arable land and generate more livelihood opportunities and income "(The Hindu Survey of Indian Agriculture, 1997).

Increasing pressure on land requires farmers to identify efficient and high productivity crops like potato (Paroda, 1999). Potato can produce more food per unit area and per unit time than wheat, maize or rice. This tuber, which has sustained ancient civilization, continues to remain a major food crop throughout the world, should no longer be considered as a vegetable, instead, and be treated as a food crop to supplement the traditional cereal diet. (Ezekiel and Shekhawat, 1999). However, potato consumption per capita in India (14.8 kg/head/year) is one of the lowest in the world (Paroda, 1999), for potato is not a part of the traditional diet and is consumed primarily as a vegetable, rather than the staple food. There is a great deal of consumer apprehension and miscomprehension about the nutritional value of potato.

Potato protein has well-balanced amino acid content and the biological value of its protein is comparable to that of eggs and milk. Yet potatoes are blamed for causing obesity and are considered by other people to be dangerous because they contain several glycoalkaloid compounds (Paroda, 1999). Despite their nutritional value, (Pandey, *et al.*, 1999) reported that 50-60 per cent of consumers were advised by their doctors not to eat potatoes during illness. Quite obviously, there is an immediate need to educate the masses on the nutritional value of potatoes to encourage greater consumption (Paroda, 1999). The medicinal use of potato is also mentioned in our Ayurvedic literature (1000-1500 BC).

The area under potato cultivation in India in 1950 was 0.24 m ha that increased to 1.34 m ha in 1999-2000 with Uttar Pradesh topping the list with acreage of 4.63 lakh ha producing 10.46 million tonnes (mt). Karnataka stands 8<sup>th</sup> in area with 39300 ha and 8<sup>th</sup> in production with a tonnage of 5.02 lakh tonnes.

Potato processing is very old and has been practiced in the highland of Peru – Bolivia for 2000 years by the Inca Indians who created ‘chuno’ and ‘papa seca’ the naturally freeze dried and dried forms of potato. In India, potato processing on commercial scale was first started by Col. Rennick in 1911, who established a factory at Narkanda in Himachal Pradesh to produce ‘potato meal’.

The demand for processed potato is likely to increase in India due to increased urbanization, preference for fast foods, rising per capita income and because of increased demand for convenience food. The most popular processed products are chips and French fries. Processing is mainly confined to developed countries and it is only in its infancy in most of the developing countries with the exception of China (12 per cent), Korea (6 per cent) and Mexico (8 per cent). In India, processing of potatoes constitutes less than 0.5 per cent of the annual production. Potato can also be processed into a variety of products ranging from potato powder, potato starch, frozen potato flakes, potato preserved in vinegar granules, baby food and alcohol. Expansion of processing industry is also desirable to avoid gluts and the consequent difficulty of storing large quantities of potatoes during periods of extremely high temperatures. With the growing realization that processed potatoes fetch considerable greater returns than fresh potatoes, processing activity is likely to look up sharply in the coming years. There is considerable scope for expansion of this processing industry in India.

The post WTO era offers countries like India immense opportunity to increase export of agricultural goods especially as raw and in processed forms. The total agricultural exports from India were valued at Rs 27347.49 crores during 2000-01, which included the traditional items like coffee, tea, spices, rice, dried and preserved vegetables, floriculture, cotton, cashew, jute etc. Exports of potato from India are dependent on five factors; firstly, there has to be export surplus. Secondly, there has to

be quality production. Thirdly, the produce should offer comparative economic advantage. Fourthly, there has to be adequate infrastructural support subject to the country's export policy. Fifthly we need an encouraging price policy and production technology. India produces large quantities of potato-in excess of 25 million tonnes, which 100 crore people of the country are unable to consume, thus generating surpluses. "The growth of potato production in India is very high which is likely to continue in future. The current gluts do not deter farmers from increasing the production. The production of potatoes has achieved such a high level that surplus of potatoes would always be there, which would favour our exports", says the Director of Central Potato Research Institute (CPRI) Dr Ezeikel.

Technologically, Indian potato is highly competitive in the world market as the potato production is free from prohibited disease like Wart, Black Scab, Ring rot, Tuber moth and nematodes which are the barometer of phytosanitary standards. Indian farmers are now competent to produce export quality potatoes for the foreign market with adoption of modern technology for production of ware and seed potatoes. Development of 35 improved varieties, the seed plot technique, potato seed production programme and zone wise package of practices by CPRI during the last 52 years has led to 5.7, 2.8 and 16 fold increase in area, productivity and production of potato, respectively in India. Potato is grown in India under shortday conditions in winter and harvested during the months from January to March when there is no fresh harvest

of potatoes in most parts of the northern hemisphere making it strategic crop from export point of view. This makes India, technically efficient and economically feasible for exporting potatoes.

The world trade for potato is dominated by Europe, which accounts for 80 per cent exports of fresh potatoes. India's share in world potato exports is miniscule at 0.5 per cent only although its share in world potato production has been ranging between 3.6 per cent in 1986 to 8.50 per cent in 2000. India exported 7219 Metric tonnes of potato in 1980-81 valued at Rs 1.18 crores, which increased to 22,637 Metric tonnes in 2000-01, which is valued at Rs 11.60 crores. The major importing countries for Indian ware potato are Sri Lanka, Nepal, UAE, Mauritius, Singapore, Malaysia, Arabia and some times Japan. Sri Lanka alone accounted for the lion's share of 77.5 per cent.

Fryer in the year 1675 mentioned potato as one of the common garden crops after a survey of Karnataka. Karnataka is one of the important potato growing states in Peninsular India. Potato is one of the main crops in six of its twenty-seven districts. The state's agro ecology favors its cultivation during two seasons a year. Potato is predominantly grown in Bangalore, Belgaum, Chikmagalur, Dharwad, Hassan and Kolar districts. It is mainly grown as Kharif crop in Belgaum, Chikmagalur, Dharwad and Hassan districts, whereas it's grown as a rabi crop in Kolar and Bangalore districts. The rabi crop is irrigated, whereas the kharif is totally rain fed. Potatoes produced in Kharif account for the major

proportion (70 per cent) of the potatoes produced in Karnataka. Hassan District stands first in area followed by Belgaum and Kolar districts.

The major portion of the potato growing area is covered by rainfall in kharif season. The rainfall in the months of April to November influences the area coverage, total production, productivity and quality of the produce. During the rabi season, potato is cultivated only in Bangalore and Kolar districts where tube wells form the main source of irrigation for the crop. Intensive cultivation is followed to get maximum returns from the investment. Hence the cost of cultivation is much higher compared to that of kharif crop.

Potato is sold by farmers in the Agricultural Produce Market Committee (APMC) markets which were established by the Agricultural Produce Market Act of 1939. With the introduction of APMC and stringent market regulations, the farmers started receiving a higher share in the consumer's rupee. Exorbitant market charges by the intermediaries, unauthorized deductions in weight and prices, use of defective weights and measures and drawing large amount of produce as sample for which no payment was made to producers, were the malpractices widely prevalent before the introduction of APMC Act. The steady growth of arrivals of commodities in the regulated markets is the result of the improvement and beneficial effect of the regulated markets owing to which the sale of agricultural produce in the village has been observed to dwindle over time. This has led to considerable improvement in the market structure, conduct and performance. The major APMC



markets for potato are Bangalore, Hubli, Belgaum, Hassan, Chikkaballapur and Kolar. Bangalore attracts the largest share of arrivals of potato among these markets. The major arrivals of potato in these markets are during October and March months corresponding to kharif and rabi crop harvest. During off-season potato from other states like Punjab and Uttar Pradesh arrive in these markets.

In Karnataka, potato is stored by farmers on the farm in local storage structures and in cold storage houses also. The storage function plays an important function of making available the produce in off-season. This practice also helps preventing glut in the market caused by dumping of the produce in the market immediately after harvest. Though area planted and yields have increased steadily over the last decade, storage facilities are still limited. Existing cold storages in Karnataka have a capacity to store less than two per cent of the total output of potatoes in the state. Thus, farmers are left with only two alternatives; either sell their tubers immediately after harvest and create a glut in the market which subsequently results in lower prices for their produce or store them on farm. Inadequate storage is one major reason for immediate sale of the produce. In India about 90 per cent of cold storage capacity is exclusively utilised for storage of potato. Nevertheless, it is sufficient only for 46 per cent of the total potato production as against an ideal requirement of 50-60 per cent. But cold stores provide a partial solution to potato marketing problems. Deficient cold storage facilities

and rise in rental charges have made the farmer to come down to the practice of on farm storage.

The substantial increase in yield of potato has not correspondingly increased farmer's income; this is in the wake of existing market facilities, supporting market arrangement and procurement policies etc., which have not kept abreast with the increasing yield and they have denied farmers the benefit of increased yield levels.

In a predominantly agricultural economy like India's, prices play a pivotal role. Due to heavy dependence on natural factors the prices of the farm product fluctuate more than that of industrial goods. Hence in a developing country like India the human and political implications created by prices are enormous. They have a profound effect on growth, equity and stability in developing economies and parallelly affect the prices of non-farm goods. The net result of many a forces acting in many directions causes changes in prices which is associated with passage of time. The various factors affecting the demand and supply of different commodities require different lengths of time to influence the time changes. A change in prices of a commodity or group of commodities in a given market is termed as market fluctuations. "Time" is the basic accompanying variable in understanding price fluctuation. The fluctuating characteristics of agricultural prices enter directly in the decision frame of farmers, both in production and marketing decisions. Fluctuation or instability in prices is the greatest source of risk next only to weather in agriculture production system.

The variation in the market arrivals and price can be classified as temporal variation and spatial variation. Temporal variations are results of complex mixture of changes associated with trend, cyclical, seasonal and irregular components. Among these, the seasonal component is considered the most important. Spatial price variation refers to the variation in the prices observed in different markets and they occur due to the difference in the location of production and consumption centres. The inter relation between price movements in different markets mostly depends upon the nature and extent of competition, dissemination of market information and the attitude of market functionaries. The efficiency of any marketing system is determined by the degree to which the wholesale prices of a commodity in different markets are related to one another. Analysing such inter relationship helps us in understanding the efficiency of the marketing system.

Stable prices are important indicators of the level of economic growth and they depict the directions for future investments in the economy. Fluctuations in prices can be attributed to the instability of production, risk in production, level of adoption of technology, market infrastructure, supporting-marketing arrangements, Government policy with respect to price support policy, procurement policy, export-import policy etc. Price stability is a precondition for stabilizing production of semi-perishable crops such as potato. Hence the need of the hour is to examine the constraints responsible for such fluctuation in prices and production of potato. Infact, economically damaging price fluctuations

have been attributed to faulty policy initiatives in India. The infrastructure facilities available are insufficient for effective handling of the present level of production. The supporting infrastructure like processing facilities, storage facilities, network of rail and road, marketing finance vis-à-vis other facilities is found to be inadequate. It is also important to workout the investment requirements on the creation of these facilities through which one can visualize the benefits accrued from stability in price and production.

### **Hypotheses**

The following hypotheses have been developed for the study.

- 1) There is an increasing trend in the arrivals and prices of potato in the major markets of Karnataka
- 2) The arrivals and prices of potato do not follow seasonal pattern
- 3) The level of market integration among major markets for potato is high
- 4) Production of potato by different producers and also product produced by same producers are not of uniform quality.
- 5) The infrastructure available for marketing of potato are inadequate to facilitate their efficient marketing

- 6) The existing infrastructure facilities for marketing of potato are insufficient.
- 7) The market concentration among traders is highly skewed for potato
- 8) There is a high potential for export of potato from Karnataka
- 9) The existing model of movement of potato from the production to the marketing point is inappropriate to utilize all the infrastructure available
- 10) The existing policies of infrastructure in marketing of potato need revision.

In view of the above situation the objectives fixed for the study were,

### **Objectives**

- 1) To analyse the trends in arrivals and prices of potato in major markets of Karnataka
- 2) To study the seasonal pattern of market arrivals and prices of potato
- 3) To study the extent of market integration among major markets for potato

- 4) To identify the constraints and potentials in the production of potato and work out feasibility of production of uniform grades and quality of potato.
- 5) To ascertain the gaps in the level of infrastructure facilities like storage, processing, transportation and marketing finance
- 6) To ascertain the constraints in the full exploitation of the capacities of the existing infrastructural facilities and workout feasibilities of absorption of increased production of potato.
- 7) To ascertain the market structure in marketing of potato and to develop appropriate model of market structure for their efficient marketing
- 8) To identify the potentials for export of potato both in raw and processed form
- 9) To suggest appropriate logistics model for efficient marketing of potato
- 10) To suggest appropriate policy measures for management of production and prices of potato in Karnataka.

## **Organization of Thesis**

Chapter I: deals with the importance and scope of the research problem, hypothesis and objectives of the study.

Chapter II: provides precise review of the concepts used in earlier studies and specifies appropriate concepts as relevant in the present study.

Chapter III: presents the socio-economic characteristics of the area under study, the database and the various analytical tools and techniques used.

Chapter IV: offers the salient results obtained from the analysis of the data collected for the study.

Chapter V: brings out the logical reasoning for the results of the study.

Chapter VI: summarise the findings and indicates policy implications.

Chapter VII: acknowledges the references made from the reports, journals, books and other sources.

# *Review of Literature*

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## II. REVIEW OF LITERATURE

Review of literature provides information to the researchers regarding the previous works done in their area of research and thereby helps them in identifying the theoretical framework and methodological issues relevant to the study. It provides the researchers a proper direction to carryout their research work and enables them to arrive at meaningful results. Keeping these facts in view, the available literature relevant to the objectives of the present study was reviewed and they are presented herein under the following headings.

2.1 Market arrivals, prices and their relationships

2.2 Market integration

2.3 Constraints in production and marketing of potato

2.4 Financial feasibility of investment

2.5 Infrastructure and extent of utilisation

(i) Storage practices of potato

(ii) Studies relating to the cost of fruit and vegetable processing units, capacity utilisation and infrastructure for exports

2.6 Market Structure

## 2.7 Export competitiveness of major agricultural commodities

- (i) Structural changes and direction of trade in exports
- (ii) Studies relating to the export constraints and export potential

## 2.8 Studies relating to the transport modelling

### **2.1 Market arrivals, prices and their relationships**

George and Govindan (1975) studied the behaviour of monthly wholesale prices and the pattern of arrival of potatoes in Ahmedabad market, Gujarat during 1966/67 to 1973/74 using harmonic analysis. The findings confirm the existence of seasonal cycles both in prices and market arrivals of potatoes. The behaviour of wholesale prices indicated the existence of a three-year cycle. However, the market arrival pattern did not indicate the presence of a similar long-term cycle. The price elasticities associated with the very short-run, seasonal and long-term cycles were - .518, .720 and .246 respectively.

Jain and Kaul (1980) analyzed the seasonal fluctuations in the potato market and the existence of cycles and worked out their periodicity, using time-series data relating to arrivals and prices collected from four major potato markets in the Punjab, India. In the case of two markets (Ludhiana and Pathankot) the data related to the years 1961/62 to 1975/76 while in the case of Jallandar and Hoshiarpur markets, the data related to the years 1963/64 to 1975/76. A multiplicative model of

time-series was used to analyze the trend, seasonal and cyclical variations in prices and arrivals of potatoes. The analysis of all the objectives showed the instability of price. There is an upward trend in prices but with large fluctuations in a year. Analysis of cyclical variations confirms the fluctuations in prices as it gave a three-year cycle period in potato prices.

Balakrishnan *et al.* (1981) studied the arrivals and prices of potatoes at Mettupalayam market in Tamil Nadu, and the specific relations between them, using time-series data for 16 years, 1962-1977. The study showed that potato price fluctuations in the selected market are governed not only by the supply of potatoes from Nilgiris, but also by the arrivals from the upcountry markets and their price. Warehousing and cold storage facilities need to be expanded to store the produce when the price is not attractive.

Findings of a study by Kalyankar and Rajmane(1987) on arrivals and prices of potato in Jalna market (Maharashtra) for 1973-82 showed that March was the peak month for arrivals while minimum arrivals were recorded in November. Seasonal price indices showed that the increase in the off season price compared with the immediate post harvest price was around 30%. The producer's share in consumer's rupee was 65.71%, i.e., Rs110.40 in Rs167.99 per quintal paid by the consumer, the remaining 34.29% being spread over different marketing agencies. The study emphasized the need to stabilize prices during peak harvesting periods by providing cold storage facilities in the producing centres and

establishing wholesale and retail markets in the potato producing area to minimize the marketing costs of potatoes.

Kainth and Mehra (1988) examined the trends and seasonal fluctuations in arrivals and prices of potatoes in Amritsar district, Punjab, together with the price spread of potatoes. The study covers the period 1980/81-1987/88. Seasonal variations may be primarily due to seasonal production, poor cold storage facilities and lack of retention power of the potato growers. Price variations play a predominant role in creating uncertainty in the income levels of potato growers. The main reason for the variation in prices was the pattern of market arrivals. Producers received only about 59% of the consumer price.

Sangwan (1989) examined seasonal variation in potato price in important markets of the country. He found that the level of seasonal variation in the prices of potato was considerably less in Delhi market than Kanpur, Farrukhabad, Meerut and Patna markets. It was largely due to lower harvest price in producing area than consuming center like Delhi. All the five markets did not show similar trend over the entire period i.e., 1963 to 1985. The direction of trend changes was largely in keeping with respect to trends in production of potato and establishment of cold storage.

Mundinamani *et al.* (1991) used monthly time series data on market arrivals and prices of groundnuts for the period 1960/61-1983/84 collected from the regulated markets of Gadag and Hubli to

estimate indices, trend equations and coefficients of variation. The pattern of market arrivals of groundnuts indicates a seasonal character. The prices of groundnuts were found to be a function of market arrivals only in the short run. The seasonal pattern of market arrivals and the resulting short run instability in groundnut prices could be eliminated by using a package of measures. In the long run, prices are influenced not only by market arrivals but also by other factors such as the general rise in prices and the steady rise in demand for groundnut products

Selvaraj and Krishnamoorthy (1991) examined the pattern of price behaviour, the existence of market channels, nature of price spread and the relationship between market arrivals and price of potato based on data collected from a sample of 10 commission agents, 10 wholesalers and 10 retailers in Nilgiris district of Tamil Nadu. The role of cooperatives in marketing is investigated using the case of the Nilgiris cooperative marketing society (NCMS) at Mettupalayam Market Centre. Two important channels for potato marketing were found: channel I (producer-NCMS- wholesaler-retailer-consumer) and channel II (producer-mandies-wholesaler-retailer-consumer). It was observed that channel I is efficient. The price behaviour analysis showed wide annual and seasonal fluctuation in prices.

Singh *et al.* (1993) concluded that stable prices play an important role in determining farm income, in particular for perishable products such as potatoes, where farmers cannot retain produce. The seasonal nature of agricultural production results in price fluctuations. This paper

analyses trends in arrivals and prices of potatoes; examines the seasonal patterns of arrivals and potato prices; and suggests measures to help minimize price fluctuations. The study was undertaken in Jalandhar district of Punjab state during 1975/76-1989/90. The results indicate a rising trend. During the post harvest period, the indices of prices remained high and fluctuated widely. These fluctuations may be attributed to the seasonal and perishable nature of the crops. The government needs to take some initiatives such as: announcing some support price programmes for potatoes; purchasing the produce at the support price directly from the producers; increasing cold storage facilities in the state; increasing the retention power of the producers by providing adequate credit facilities; and establishing more potato processing units in the potato growing areas, thus providing employment to the rural community.

Keith *et al.* (1997) examined seasonal potato price indices for two major wholesale potato markets of Delhi and Kolkata. It was cleared that potato prices typically double between the end of harvest in March and the onset of summer in July and August. The most rapid increase in potato prices occurs in April and May. There was a slight dip in price in the Delhi market in mid summer which may reflect the arrival of a summer crop. Prices then continue to rise until peaking in September or October when existing stocks are lowest, and just prior to the arrivals on the market of early potatoes in months of November and December.

Mipramavar and Gummagolmath (1998) studied seasonal indices of arrivals and prices of potato in regulated markets of Northern Karnataka. They revealed that the arrivals were maximum in the month of November in both Belgaum and Dharwad the markets indicating glut during harvesting season. This situation prevailed mainly due to lack of storage facilities in the area. However, price did not decrease during glut season as majority of the traders purchased potato at that time in Belgaum market. The seasonal index of arrivals and prices revealed that the seasonal fluctuations in arrivals of potato were more than that of price in Belgaum market. So Belgaum market clearly represents the characteristic feature of wholesale assembly market. That means the seasonal index of arrivals reached its maximum during the harvest season and post-harvest period. From the above reviews, it is clear that the market arrivals were higher in the months of March and April, and price also had shown decrease at peak period, whereas, price was higher from September to December in the lean period. The arrivals had shown increasing trend from 1989 to 1999 in Belgaum market because of increase in the production of potato. The seasonal fluctuations were more in both price and arrivals due to lack of storage facility and lack of market information.

Ravi Kumar *et al.* (2001) concluded that, in general, arrivals showed mixed trend, whereas, prices showed an increasing trend for the selected commodities in Anakapalle regulated market of Andhra Pradesh. There exists an inverse relationship between seasonal indices of arrivals

and prices of selected commodities. Therefore the policy implication lies in encouraging the farmers to dispose their produce at the opportune time to get good remunerative prices. It requires providing finance to farmers and better storage facilities either at village level or at market level so as to spread the arrivals reasonably in the lean months of the year.

Shivaraya and Hugar (2002) inferred that the prices of onion and potato increased as there is increase in arrivals in Belgaum, Hubli, Raichur and Gulbarga markets. However, reverse trend was observed in other markets. The correlation co-efficient between arrivals and prices of onion showed negative association in storage cost Dharwad, Bijapur and Raichur markets and potato in Dharwad market. This clearly indicated that the prices of onion and potato were mainly influenced by their arrivals in these markets in accordance with the law of demand and supply. The substantial quantity of arrivals during post harvest months of the year led to decline in prices. The development of warehousing facilities and provision of credit to the farmers against warehouse receipts would go a long way in reducing the variation in arrivals and prices. This also calls for dissemination of market information relating to arrivals, prices, etc, by the respective Agricultural Produce Market Committees.



## 2.2 Market integration

The market integration concept explains the relationship between two markets that are spatially or temporally separated. A study on integration of different markets can suggest to the producers as to where, when and how much to sell, which in turn will have a bearing on their production strategies and hence resource allocation.

Lundahl and Peterson (1982) studied the market integration for major food grains during the period 1969 to 1974. The numbers of markets considered were nineteen for rice, eight for grain millet, twenty for grain corn, eleven for ground corn and fifty for seed beans. Monthly price series were detrended and the residuals were correlated. The results of the study revealed that there was no higher correlation between the residuals.

Brorsen *et al.* (1984) illustrated the use of univariate and multivariate time series analysis in the investigation of dynamic relationship among selected weekly import prices of rice of the European community. EC imported rice from the United States, Thailand and Argentina. The results showed that Argentinean and United States prices moved together. These two prices were influenced by the European market and react quickly to changes in Thailand prices. Thailand prices responded slowly to US and Argentinean prices.

Bhatta and Bhat (1988) analysed the extent of price relationship for arecanut between selected markets of Sirsi and Mangalore using the

correlation coefficient method. The results revealed that Mangalore market was more efficient than Sirsi market. The commercial nature of the crop and its varied market behaviour was clear from the fact that there was a direct relationship between supply and price.

Indira (1988) estimated the extent of price relationship for coffee between three pool sale centres - Bangalore, Coimbatore and Vijayawada. The results revealed that Bangalore prices have shown positive relationship with both Coimbatore and Vijayawada prices. Coimbatore and Vijayawada prices have also shown positive relationship with each other. However, there was relatively lower influence of Bangalore prices on Coimbatore prices than on Vijayawada prices.

Prabhakar (1988) studied the market integration of silk cocoon markets of Ramanagaram and Vijayapura in Karnataka. The association between the two markets was studied using the bivariate correlation analysis. The correlation coefficient was found to be 0.947 and was highly significant at 1 per cent level of significance, indicating that the two markets were highly correlated.

Gemtessa (1991) analysed the integration of Ethiopian coffee prices with world prices using the correlation co-efficient. The correlation co-efficient of the monthly average prices secured at domestic and world markets for 12 months lag were calculated. The bivariate correlation co-efficient between the two market prices of coffee revealed that they moved together in the same direction. The lagged cross-correlations of domestic

prices and world prices of coffee also revealed that they moved together in the same direction. The lagged cross-correlations of domestic prices and world prices of coffee for the period 1979-80 to 1987-88 indicated that the world prices of coffee had a stronger influence on the domestic prices, than that of domestic price influence on world prices of coffee.

Ahmad Zubaidi and Muzafar Shah (1994) examined the price efficiency in pepper markets in Malaysia. Co-integration tests of spatial price relationships were applied to weekly black pepper and white pepper prices at 6 regional markets in Sarawak, Malaysia using data for the period 1986 to 1991. The results revealed that the regional pepper markets in Sarawak were highly integrated. Price changes are fully and immediately passed on to the other markets. The low transportation costs and risk associated with transportation may explain the degree of co-integration observed.

Saikat and Nair (1994) studied whether the movements in the international prices of Indian pepper had reflected the variations in prices in other exporting countries during the 1980s and also whether the domestic prices of pepper had moved synchronously with international price. The results revealed that due to the open trade status for pepper, the prices have moved synchronously indicating the integration of prices in the world pepper market.

Mamatha (1995) used the co-integration analysis for examining the market integration of selected species of India and New York prices. The

results indicated that the co-efficients were found to be negative and significantly different from zero in case of Indian and New York prices of pepper, chillies, turmeric and ginger confirming the stationarity of the series. It also indicated that both the Indian and New York price series for selected spices had the same order of integration.

Debdutt Behura and Durga Charan Pradhan (1998) analyzed the relationship between prices of marine fishes for six markets in Orissa by using co-integration model. The results revealed that out of all the six markets, the price series between Cuttack and Paradip were co-integrated due to good communication facilities.

Hudson (1998) analysed the changes in the price behaviour in US catfish industry. Using monthly catfish price data, a co-integration analysis of subsets of prices showed that price behaviour has changed through time with catfish prices becoming integrated as the number of processors has increased. The results may have implications for the examination of market price behaviour in developing or emerging markets.

Thorsen (1998) studied the spatial integration in Nordic timber market. The degree of spatial integration was tested through a co-integration analysis and a complete identification of the statistical models for long-run structure. When the results were interpreted in terms of factor price equalization and efficient commodity arbitrages, the Nordic timber markets were found to be strongly integrated.

Bassolet and Lutz (1999) analysed the integration of cereal markets in Burkina Faso which were liberalized in 1992. At the same time a market information service (SIM) was created to collect and disseminate weekly cereal prices of regional markets by radio. The study evaluated up to what extent the existence of this service contributed to the integration of the market using co-integration analysis. A comparison of results of the whole period under study (1990 to 1995) with the results of the period after SIM (1992 to 1995) showed that the impact of the diffusion of prices on market integration is moderate.

Khedhiri (1999) in his study on the agricultural market integration in Tunisia found that the degree of wholesale market integration is low, particularly for the strategic products. It also showed that the distance between markets and the volume of transactions cannot explain this lack of linkage between the markets.

Olani Wirtu Wakjra (1999) studied the long-run relationship between international price (New York) and producer's price of coffee in Rwanda. The results indicated that both the price series were stationary and were integrated due to better infrastructural facilities.

Samarajeeva and Gunatilake (1999) studied the demand function for coconut using co-integration analysis. The study made use of 20 years Sri Lankan time series data (1978 to 1997) to estimate the demand function for coconut oil incorporating own price, 3 substitute prices and income. The results of Dickey fuller and augmented Dickey fuller tests

revealed that the quantity consumed and prices of palm oil are integrated to the order zero while prices of coconut oil and Soya oil and income are integrated to the order one.

Zanias (1999) analysed the seasonality and spatial integration in agricultural (product) markets especially the soft wheat market of five European Union member states (France, Italy, Belgium, Germany and UK). Co-integration analysis was made use of by incorporating the seasonal components of the agricultural price series in the testing procedure. The results showed that some of the markets turn out to be integrated while in some cases a unified market cannot be assumed. These results differ in some cases from those obtained by co-integration tests which ignore seasonal unit roots.

Balappa shivaraya (2000) used zero order correlation matrix to study the potato and onion markets in North Karnataka. He observed a strong integration among all the selected markets both in onion and potato except Bijapur in onion. In case of potato, the correlation co-efficient between wholesale prices of selected markets was found to be higher than 0.93 indicating greater integration among Belgaum, Dharwad and Hubli markets.

Mahesh (2000) studied the relationship between domestic (Calcutta) and international (London) market price series of tea using the co-integration analysis. The results revealed that the tendency of the

price series of both domestic and international market for tea move in-unison in the long-run confirming the law of one price (LOP).

Jayesh (2001) studied market integration for spices using correlation coefficient. The zero order correlation matrix of prices showed a strong integration among the selected markets of Kerala, Karnataka and Tamil Nadu for both pepper and cardamom.

### **2.3 Constraints in production and marketing of potato**

Patil *et al.* (1969) revealed that the growth of horticultural plantations in Maharashtra had been hindered by a variety of economic problems. They listed the reasons as uneconomic size of plantations, improper selection of lands for the fruit crops, selection of inferior varieties, faulty growth of trees, insufficient manuring, inadequate irrigation, non-availability of markets for efficient and prompt disposal of the produce, irregular and heavy seasonal supplies, heavy marketing costs, perishable nature of the products, absence of organized marketing services, lack of market intelligence, price fluctuations, absence of inadequate facilities of storage and processing. Because of these complex problems the cultivators did not get economic returns and as a result, in many cases, the growers were forced to uproot their horticultural plantations.

Subramanyam and Mrutyunjaya (1978), based on their study on marketing of fruits and vegetables in Bangalore suggested for: (1) regulation of marketing of fruits and vegetables with (a) proper dialogue

with all the concerned people in the trade to fix reasonable commission, so that the commission is neither too low as suggested in the Act nor too high as at present, and (b) strict supervision, (2) :creation of vegetable marketing organization units with (a) assembling centres located at growing areas, (b) arrangement for payment of loans/advances and supply of inputs, and (c) arrangement for transportation and packing of the produce, (3) creation of commodity marketing boards to individual or group of fruits and vegetables to take care of both supply and marketing, (4) establishment of retail outlets to protect the interest of the consumers, (5) providing cold storage facilities, and (6) dissemination of market intelligence through all possible means of communication for improving the marketing efficiency of fruits and vegetables.

Nagaraj *et al.* (1985) in their study on market appraisal of fruits and vegetables documented the problems of vegetable producers and intermediaries wherein about 90 per cent of the farmers reported that intermediaries refused to accept the produce of graded vegetables tomato, brinjal, cabbage and beans. The other problems felt were lack of storage facilities and delay in getting sale proceeds from the intermediaries, high rate of commission, improper weighment, wide fluctuation in prices and high unloading charges at market. However, commission agents and the retailers complained about congestion in market-yard, which made it difficult to transact the heavy market arrivals received throughout the year. Therefore, the measures suggested by them for the above problems were: (i) regulation of markets and equipping with a network of



infrastructural facilities ranging from scientific storage to transportation and processing, (ii) regulation of future trading, (iii) spreading of the tentacles of co-operative marketing and reducing their procedural formalities involved encourage producers, (iv) financing of marketing of perishables by providing loans for purchase of well ventilated vehicles for transport of fruits and vegetables.

Singh *et al.* (1988) reported that lack of adequate supply of inputs, high transportation cost, shortage of railway wagons, low prices, lack of industrial uses of potato, large surplus and distress sales were the major problems in potato marketing and storage in Farrukhabad district of Uttar Pradesh.

Pamer *et al.* (1994) reported that spoilage was the major problem (68.46%) during marketing of vegetables in south Gujarat followed by malpractices in weighment (49.4 1%), lack of credit facilities (24.40%) and inadequate transportation facilities (23.8 1%).

Thakur *et al.* (1994) identified the problems encountered by the farmers in marketing of vegetables. They were (1) unorganized marketing and low prices paid to farmers, (2) lack of mechanical grading, packing and proper storage facilities, (3) malpractices, high and undue marketing margins and costs in the markets, (4) lack of village roads; lack of sufficient and low cost transportation facilities, (5) lack of market information and market news, and (6) lack of processing units and co-operative societies.

Sharma *et al.* (1995) in their study on marketing of vegetables in Himachal Pradesh reported that costly wooden boxes, time consuming manual grading, distant markets, high transportation charges, malpractices in the market and lack of market information were the major problems faced by growers in storage, transportation and marketing of vegetables.

Bonny (1996) surveyed the constraints in commercial production of vegetables in Pananchery and Puthur, Kerala and reported that increased cost of plant protection chemicals was perceived as the most important factor by the respondents. This was followed by adequate marketing facilities, poor storage and other post harvest facilities, insufficient capital and high labour costs

Jairath (1997) in his study on operational efficiency in fruits and vegetable market in Jaipur examined the effect of operational efficiency on marketing efficiency. The study revealed that though the system of sale was by way of open auction, yet a very small portion of produce was sold by this method mainly because of non-participation of sufficient number of traders in the auction and lack of adequate space for display and handling of the produce. The traders were still deducting unauthorized charges and payments of sale proceeds were not realized by the farmers on the same day.

Patel *et al.* (1997) in their study on marketing efficiency of Anand vegetable market in Gujarat reported that lack of storage facilities, delay

in payment of sale proceeds, high cold storage charges, monopoly of a few middlemen and need of timely disposal of these perishable products etc., were the major problems faced by the cabbage and cauliflower growers.

Narappanavar and Bavur (1998) examined the problems in storage, transportation and dissemination of market information in potato marketing in Dharwad, Karnataka and found that farmers were facing several problems in transportation because of large number of tractors in the villages. Similarly, farmers were making suitable arrangements for storage of potato on the farm itself. However, about 35 per cent of the farmers complained of illegal deductions while selling the produce at the market in the form of weighment charges. The other problems noticed were lack of grading facilities, arbitrary hamali charges, low and variations in output prices and high commission charges. Therefore, it is suggested that there is need for ensuring improved storage facilities and purchase of potato at the local market by the government at the time of heavy arrivals to assure the remunerative returns to the potato growers.

Anilkumar and Arora (1999) in their study on post-harvest management of vegetables in Uttar Pradesh hills found that non-availability of cold storages, highly perishable nature of the vegetables, low market demand for the produce at the time of storage are the major problems as perceived by farmers in vegetable storage. Farmers have also reported the reasons for selling through particular buyers/commission agents as: i) accessibility of buyers, ii) remunerative price, iii) less

marketed surplus, iv) convenience in sale, v) receipt of advances, vi) minimum cost on transportation and vii) frequency in selling being low.

Nagaraja *et al.* (1999) identified the most important constraints in production and marketing of potato in Kolar district of Karnataka by assigning the ranks. In production, high cost of seed material and diseases (rank-I) were the major constraints followed by frequent power failure (rank-II), high cost of fertilizers and plant protection chemicals (rank-III), scarcity and high cost of labourers (rank-IV), and non-availability of good seed material on time (rank-V). The frequent fluctuations in price (rank-I), involvement of too many middlemen (rank-II), delayed payment (rank-III), insufficient storage facilities (rank-IV), low output prices (rank-V) and high market charges (rank-VI) were the main constraints in marketing. Under the circumstances, it was suggested to encourage farmers to take up tuber treatment with sufficient time to avoid occurrence of disease, practice of weedicide application to avoid high cost of labour especially during scarcity period and adoption of scientific production technologies and marketing strategies so as to get maximum returns.

Vasudev and Chowdry (1999) identified problems of production and marketing of tomato in three regions of Andhra Pradesh. Lack of grading facilities, absence of market information and spoilage and malpractices were the major problems in tomato. They have concluded that providing these facilities can improve the marketing efficiency and will help the farmers in realising better prices.

Balappa Shivaraya (2000) reported that non-availability and high cost of seeds, especially during sowing period, and lack of technical knowledge for adoption of improved varieties were the major constraints in vegetable cultivation as perceived by the farmers. The supply of spurious hybrid seeds and plant protection chemicals, high incidence of pests and diseases, particularly in tomato and brinjal, were the other two impediments as expressed by majority of the farmers. Among the marketing problems, wide price fluctuations with day to day variations and variations within the same day, especially in highly perishable fresh vegetables like tomato and brinjal, were the major constraints as opined by the farmers.

## **2.4 Financial feasibility of investments**

Anonymous (1985) computed a few measures of project appraisal involving the cash flow discounting techniques for the small holder plantation crops inclusive of cardamom. The techniques used were Benefit Cost ratio, Net Present Worth and Internal Rate of Returns. They considered 12 years as the economic life period of cardamom. The Net Present Worth, Benefit Cost ratio and Internal Rate of Return were Rs.13,700 (at 14 per cent discount rate), 1.42 and 25 per cent, respectively.

Kamal Kumar Datta *et al.* (1989) analysed the productivity, profitability and financial feasibility in capture fishery in Orissa coast. From the selected nine centres, twenty sample units in each of the

centers were taken randomly for mechanised and non-mechanised units. The Net Present Value (NPV), Internal Rate of Return (IRR) and Pay Back Period criteria were used to work out the financial feasibility of investment. The results of the study revealed that NPVs for all types of units were positive indicating the financial feasibility of the investment for all types of units. The IRR in all types of units was impressive and ranged from 12.97 to 18.50 per cent. The payback period showed that most of the non-mechanised units were able to repay their initial investment amount within a year.

Anaman and McMeniman (1990) evaluated the performance of purebred and crossbred dairy cattle under on farm conditions in tropical northern Australia. Production data on Australian Friesian Sahival, Holstein - Friesian and other cattle mainly Australian milking zebus, all kept on privately owned farms were used to compute the expected Net Present Value of income per cow during its life time. The Net Present Value (NPV) was obtained by discounting future net income values by the opportunity cost of capital and was calculated for each breed using the equation  $NPV = \sum (R_t - C_t / (1+r)^t)$  where ' $R_t$ ' is the gross return from a cow in the year ' $t$ ', ' $C_t$ ' is the total cost of maintaining a cow in year ' $t$ ' and ' $r$ ' is the discount rate reflecting the opportunity cost of capital. The productive life span of a cow was assumed to be 8 years. Under 1988 economic conditions in northern Australia the NPV was found to be 285, -27 and -652 Australian dollars for the three breed types, respectively.

Azad and Sikka (1991) analysed the production and marketing of temperate fruits in North-West region of India. The cost of cultivation, marketing system and economic viability of fruits such as apple, peach, plum and apricot were examined. The application of project evaluation measures of orchard investment revealed that the Net Present Value was Rs.26,257 for apples, Rs.89,222 for peaches, Rs.1,17,837 for plums and Rs.1,60,541 for apricots. The Internal Rate of Return was about 22, 33 and 47 per cents for apple, peaches and apricot, respectively. Similarly, the Benefit Cost ratio was 1.36, 3.87, 4.62 and 5.10 for the four crops, respectively.

Osemeobo (1991) studied the forest land use in Bendel, Nigeria using the data collected from farmers and forestry service personnel. Profitability of three forestland use practices – mixed food crops, agroforestry and pure stands of *Gmelina arborea* was investigated. The results revealed that all land uses were financially profitable. Net Present Values, Benefit-Cost ratios and Internal Rate of Return per hectare were respectively \$880.59, 2.9 and 29 per cent for food crop production; \$1324.05, 2 and 10 per cent for agroforestry; and \$198.90, 1.2 and 8 per cent for *Gmelina arborea* plantations.

Pathania and Sharma (1995) examined the economic viability of different sized biogas plants in Haryana. Capital budgeting techniques including Benefit-Cost ratio, Net Present Value, Internal Rate of Return and Pay Back Period were made use of in the analysis. The survey data included 100 janata type biogas plants comprising 20 each of 2, 3 and 4

cubic meter capacity and 40 of 6 cubic meter capacity. All four economic performance measures were positive indicating the economic viability of janata type biogas plants.

Korikanthimath *et al.* (1997) conducted a study regarding the economics of mixed cropping of cardamom in arecanut gardens. The results revealed that the cost of cultivation was higher in mixed cropping than under monocropping of arecanut. The net returns of Rs.1,61,837 per hectare realised in mixed cropping was 1.56 times higher over monocropping. The incremental net gain in mixed cropping was Rs.58,211 per hectare. NPV and Benefit-Cost ratio (BCR) were found to be higher by 1.48 and 1.01 times, respectively, under mixed cropping as compared to monocropping.

Basavaraja *et al.* (1999) evaluated the economic feasibility of vegetative and mechanical barriers used for soil and moisture conservation in the medium black soils of the northern dry zone of Karnataka. These conservation barriers were found to repay the initial investment within a short span of one year. The Net Present Value of the conservation measures were found to be not only positive but also appealing, having IRR more than 100 per cent and Benefit-Cost ratio more than two.

Biju (1999) analysed the feasibility of introducing cut flower production in Kanyakumari district of Tamil Nadu. For analysing the feasibility, various investment indicators such as Net Present Value,



Benefit-Cost ratio and Internal Rate of Return were used. The analysis indicated a high NPV value for both orchids and anthurium. The BCR value was worked out as 1.22 and 1.08, respectively, for orchids and anthurium indicating the worthiness of the project. Similarly, the Internal Rate of Return was found to be 33.50 per cent and 23.24 per cent for orchids and anthurium, respectively, indicating the advantage of cut flowers in general and orchids in particular.

Nalini Ranjan Kumar *et al.* (1999) examined the economic viability of Aril watershed development project in Bareilly district of Uttar Pradesh. The results indicated that the project was economically viable with Rs.252 lakhs as NPV and 1.39 as BCR at 12 per cent discount rate. The project also withstood increase in costs by 10 per cent and decrease in benefits even to the extent of 20 per cent.

Korikanthimath and Hiremath (2000a) studied the economic feasibility of cardamom cultivation on steep slopes of Western Ghats. The study revealed that the annual average maintenance cost was Rs.53,664.86 per hectare. Out of the various inputs, maximum expenditure was incurred towards labour indicating the labour intensive nature of cardamom. A net income of Rs.74,488.95 per hectare was obtained with a production cost of Rs.88.01 per kilogram (dry). The economic feasibility measures such as NPV (Rs.1,55,476.33/ha) and BCR (2:1) indicated the viability of investment on cardamom even on steep slopes.

Korikanthimath *et al.* (2000b) conducted a field trial at Sirsi to study the feasibility of cultivation of cardamom in coconut gardens in high ranges of Western Ghats. The study revealed that the cost of establishment of cardamom in coconut gardens was Rs.41,171 per hectare. The cost of cultivation of cardamom during bearing period worked out to Rs.35,896.32 per hectare. On an average, the gross and net returns realised in the mix cropping system were Rs.96,000 per hectare and Rs.64,478.24 per hectare, respectively. The Net Present Value (Rs.1,12,187.45), Benefit-Cost ratio (1.88) and Internal Rate of Return (60.31%) have justified the viability of cardamom cultivation in coconut gardens. Estimated Pay Back Period indicated that the investment on cardamom could be recovered in four years.

Patil *et al.* (2000) evaluated the economic feasibility of teak plantation in Nagpur forest circle in Maharashtra state. For testing the economic viability, project evaluation techniques were used. The Benefit Cost ratio, Net Present Value, Profitability Index, Pay Back Period and internal rate of return (at 12 per cent discount rate) were 5.77, Rs.1,02,275, 9.49, 9 years and 34.88 per cent, respectively, while the corresponding figures at 15 per cent discount rate were 4.19, Rs.52,003, 6.30, 9 years and 33.24 per cent. This indicated that all the parameters of economic feasibility test turned out to be favourable, thereby justifying investment in teak plantations which was found to be economically a viable proposition.

Singh *et al.* (2000a) conducted an economic feasibility analysis of *Acacia* species under agro-forestry system of plantation in Sultanpur district of Uttar Pradesh. To test the economic feasibility, the net present value, benefit cost ratio and internal rate of returns of *Acacia* were worked out. The benefit cost ratio (1:3.72), IRR (44.22%) and net present value (Rs.14,836) showed a higher economic feasibility of *Acacia* species.

Singh *et al.* (2000b) carried out an economic analysis of afforestation of community lands in Uttar Pradesh hills. In this connection, each of the three types of plantations namely bhimal, chir and bhimal plus chir in the Ramganga catchment area of U.P hills was found to be financially feasible at both 5 and 10 per cent discount rates in terms of both the Gross Benefit-Cost ratio (GBCR) and Net Present Value (NPV) criteria. The Bhimal plantation was a financial feasible proposition even at the 15 per cent discount rate and of the three types of plantation; it had the highest paying capacity.

Sukhjinder and Dhaliwal (2000) examined the economics of Poplar cultivation in Punjab state. Three types of agro forestry systems (AFS) were studied: AFS-I (wheat-kharif fodder), AFS-II (sugarcane for first three years and then wheat- kharif fodder for the successive years) and AFS-III (Potato- kharif fodder for the first year and wheat- kharif fodder for the successive years). The higher Net Present Value of Rs.1.16 lakhs per acre in Ludhiana was found for AFS-II in the sixth year while it was Rs.1.27 lakhs per acre for AFS-II in both the districts: 53.82 per cent in Ludhiana and 231.72 per cent in Ropar district. The Benefit-Cost ratio

was the highest in the sixth year (4.79) for AFS-II in Ludhiana 5.43 for AFS-III in Ropar district.

Jayesh (2001) used NPV, IRR, BCR and PBP for analysing the financial feasibility of pepper and cardamom plantations in Kerala and Karnataka. The financial feasibility analysis revealed that the investment in pepper and cardamom plantations in the states of Kerala and Karnataka was economically sound even under the risks of increase in costs and decrease in returns.

## **2.5 Infrastructure and extent of utilization**

Heifiner (1966) used quadratic programming to select combination of grain storage activities and future trading activities that minimize revenue variance for various levels of expected storage revenue. Solutions are presented for combinations of up to 20 activities involving the storage of three different grains in Michigan. The solution illustrates that unhedged seasonal grain inventories and non-diversified inventories are inefficient relative to fully hedged diversified inventories.

Ramasivan *et al.* [1966] found that farmers sold only 14.5 per cent of the total produce and retained the rest 76.6 per cent in storage structures. The structures used to store were mud pot, jute bags, tins, drums, thekkas and kutulas. Most of these structures, excepting tin drums, had insect damages due to presence of cracks and crevices. The grains were stored for a period of 2 to 6 years, and it was found that there was 2.9 to 17.6 per cent weevilled grain and 0.8 to 2.2 per cent

germ eaten grain. The quantitative loss in food value was 2.03 to 9.52 per cent. Next to tin drums, jute bags were found to be the best.

Rao [1973] reported that the cost of storage per tonne per annum was Rs.12.87 in case of conventional bagged storage and Rs.16.90 in R.C.C. flat roofed godown. In addition, the annual maintenance and fumigation cost amounted to Rs.2.80 and an operational labour cost of Rs.).30 per tonne in conventional bagged storage and Rs.1.30 in R.C.C. flat roofed godown. This included costs of both loading and unloading bags. Solutions are presented for combinations of up to 20 activities involving the storage of three different grains in Michigan. The solution illustrate that un hedged seasonal grain inventories and non-diversified inventories are inefficient relative to fully hedged diversified inventories.

Sen [1973] presented a stochastic model for estimating either the demand of different material inputs or the content of storage at any time and optimal order quantity depending on the storage and distribution costs. The total cost was taken as the sum of costs of carrying inventory and storage. Assuming knowledge of capacity of the storage, the content of storage at any time  $T$  can be estimated from the relation.  $Z_t = Z_{t-1} + X_t - Y_t$ , where  $Z_t$  = required constant inventory level at time  $T$ ,  $X_t$  = order quantity at the beginning of the interval.  $Y_t$  = uniform demand occurring at an "n" review interval [when  $n$  = integer,  $t = T_n + 1, 1 = 0, 1, 2, 3 \dots \dots$  ].

Alaouze *et al.* [1978] used dynamic programming to examine whether Australia should store wheat for subsequent sale at higher prices. The dynamic programming model was developed assuming that the demand for Australian wheat is perfectly elastic at the world price. The major conclusions of the study are: [1] Apart from interest rate, the most important factor affecting storage in any season is the price in the following season: (b) the holding of a speculative reserve to be sold in

Singh and Khosla [1978] discussed the magnitude of food grain losses at various post-harvest storage. The results of various studies at different centers by different institutions were presented. The transit and storage losses in food grains are estimated at between 1.03 per cent and 1.09 per cent of the value of sales during 1969-73. The total range of loss in rice and different post harvest stages is estimated between 10 per cent and 37 per cent.

Raheja and Mehrotra [1980] found that of the total production of food grains for kharif and rabi seasons, 26 per cent and 60 per cent respectively were stored by farmers for various purposes such as house consumption, seed, delayed sale or use for payment in kind and animal feed. The proportion of production kept for storage showed a declining trend as size of holding increased although the absolute quantity stored was positively associated with the size of holding. Separate storage structure was used only on large land holdings. Traditional containers were used by 75 per cent of those without separate storage rooms and these were much more liable to damage and loss, rodents and moisture

being the major destructive forces. Metal bins were used by only 25 per cent of farmers but 80 per cent of cultivators were not satisfied with their existing storage facilities and were keen to change.

Recto[1980]undertook a study with an aim to improve the paddy/rice marketing system by determining optimal sizes and location: of warehouses and investigating ways by which the marketing costs o the product could be minimized. He examined the transport and storage systems in each of the 13 regions of Philippines during 1975-77. He found that warehousing facilities were inefficiently located, with shortages of storage facilities in some regions and surpluses of storage in some others mainly due to rise in prices.

Sampajpati *et al.* [1980] compared low cost structures for storage of paddy by farmers in Bangladesh and showed that oval bins made of bamboo splits and plastered with mud and cow dung were the most suitable.

Saxena and Mathur [1980] examined the relationship between seasonal price variation and profitability of storage of wheat and the relative economics of various methods of storage, using data collected from a sample of 148 cultivators in Bijapur block, Agra, Uttar Pradesh for the year 1974-75. Three methods of storage-bulk, bag and Kuthila were analyzed. Storage profit showed a direct relationship between seasonal price variation and period and existing available railway transportation constraints. The results reveal that the storage space requirements are

directly related to the assumed level of initial stocks and that storage space needs to be larger in surplus states to minimize transportation and storage costs. Magnitude of inter-state movements and transportation costs decrease with the increase in initial stock and states with initial stocks need to be avoided from further burden by additional shipments which increase the total costs per unit of handling.

Singh and Rao (1983) studied the modes of storage of food grains in different size groups of operational holdings. In case of wheat, it was observed that the most common practice of storing was in kunala and bags. However, among the small and medium type holdings, more than 50 per cent of the food grains was stored in bags, while the cultivators of large holdings stored more than 50 per cent of it in others (Khatti, Matka, etc.) more or less a pattern similar to what was observed in respect of grain in all the categories. As regards barley, it was seen that among small holdings, 59-75 per cent of it was stored in kuthalas while medium and large type holdings stored 60-71 per cent of the produced in bags. The same practice was observed in both the years. Maize and bajra were commonly stored in bags by all the three types of holdings (small, medium and large). Cultivators of medium and large holdings small holdings stored about 88 per cent of the paddy in bags as against storing 55 per cent and 63 per cent, respectively. Thus bags constituted the most common mode of storage followed by kunala.

Kumbhare and Sirohi (1981) assessed the optimal spatial distribution of storage capacity across the states of India and worked out



the corrective interstate movement involved in the transitory phase of obtaining optimum quantities. A linear programming model used aims at minimization of costs of transportation and storage in both surplus and deficit states, subject to quantity balancing equations in others. There had been an improvement in the production of rice, (but there was a corresponding improvement in marketing infrastructures and services, a large amount of the crop are lost through inefficient handling and processing.)

Lingamurthy *et al.* (1981) reported that regulated market provides storage facilities to the farmers who want to wait for a fair price. The Warangal Agricultural Market in A.P. has 2100 metric tones storage capacity, which is sufficient to cater to the needs of the farmers of the market center. Moderate rates are charged for storage. But this storage accommodation is only a temporary one ranging between 15 and 30 days. The godown charges are 4 paise per bag per day for all agricultural Commodities, except chillies, for the first 15 days and 6 paise per bag per day for the next 15 days. For chillies, the charges are per day per bundle 12 paise and 18 paise for the same periods

### **2.5.1 Storage practices of potato**

Singh *et al.* (1988) study of storage effects on economics of potato marketing in Farrukhabad district of Uttar Pradesh. They examined that the net price-spread was higher (71.59 per cent), when the potato growers sell in off-season after storing it in cold storage, which was due

to high prices during off-season. Against this, during pre-storage period, the producer's share in consumer's price worked out to 61.67 per cent. The marketing charges paid by the producer were highest during pre and post-storage period. It means that storage plays an important role in providing higher price to the potato growers.

De (1989) examined the role of cold storage in marketing of potato in West Bengal. He found that the existing cold storage capacity has been created predominately in the private sector, which in 1987-88 owned 85 per cent of the cold storages and 92 per cent of potato was stored in private cold storages. The interest of all connected stores and the collusion of interests have resulted in the formation of strong group of potato traders. The cold storage owners also play an important role as lenders to poor farmers with the guarantee of potato supply immediately after harvest on a fixed contract price.

Singh Prem *et al.* (1996) observed that two types of indigenous storage methods were in vogue (i) heap storage, (ii) ordinary room storage. It was observed that 37 per cent of the total sample farmers stored various quantities of potatoes (5 to 200 quintal) indigenously for a period up to 90 days. The gross returns worked out to be Rs. 79 per tonne.

Verma (1996) found that the average cost of storing of potato in cold storage worked out to Rs. 50.00 per quintal by storing potato at the prevailing rate of Rs. 200 per quintal in a cold storage during 1991-92.

The producer could earn a margin of about Rs. 75.00 per quintal by selling it as seed potato at the rate of Rs. 325.00 per quintal during the months of September and October. It is therefore very essential to establish cold storage at village level for improving the marketing system for potato.

Ilangantileke *et al.* (1997) computed the storage cost at Rs. 1170 per tonne. This consists of storage charges (Rs. 656 per tonne), loading and unloading charges (Rs. 43 per tonne), cost of gunny bags (Rs. 177 per tonne), transportation cost (Rs. 101 per tonne) and losses during storage (Rs. 102 per tonne) 61.67 per cent, whereas, the marketing charges paid by the producer were highest during pre and post-storage period. It means that storage plays an important role in providing higher price to the potato growers.

Ravikesh and Singh (1997) revealed that in storage cost, the cost of godown rent was higher for all farms which were Rs. 40 per quintal, showing 43.40 per cent to 45.20 per cent of the total cost of storage between different farm categories. It was followed by cost of packing, grading, gunny bag and sutli. During storage period, damaged potatoes on a large scale had to be disposed off at the spoilage charge of Rs. 8.94, Rs. 5.91 and Rs. 5.82 per quintal to small, medium and large farmers respectively. The maximum losses were reported in case of small farmers because of their poor harvesting as well as low quality of packing material used for storage.

### **2.5.2 Studies relating to the cost of fruit and vegetable processing units, capacity utilisation and infrastructure for exports**

Anonymous (1976) in a study on the integrated development of horticulture in Karnataka emphasised the need for development of processing industries for utilizing fruits and vegetables during the glut period, thereby stabilizing the prices in the market and for making available the seasoned fruits and vegetables during off-season. It was observed that of the 0.025 million tonnes of existing installed annual capacity, the per-year utilization was only 0.012 million tonnes. The report has also suggested measures for strengthening and streamlining of existing units in addition to the proposal for starting new units.

Anonymous (1984) in a feasibility study on the feasibility of establishing fruit and vegetable processing complex at Bangalore reported that the estimated cost of the processing plant was Rs.163.19 lakhs and it was composed of a fixed investment of Rs.139.07 lakhs and a working capital of Rs.24.12 lakhs (margin money at 100 per cent capacity utilization). The fixed capital investment consisted of investment on land of Rs.6 lakhs, Rs.37.33 lakhs on buildings, Rs.67.4 lakhs on plant and equipments, Rs.6.73 lakhs on pre-operative process expenses, Rs.11 lakhs on vehicles, laboratory equipments, tools, office furniture and fire fighting equipment, Rs.8.61 lakhs on contingencies and Rs.2 lakhs on deposits against various facilities. With this facility, 15 tonnes of raw mangoes was estimated to yield 8.40 tonnes of pulp, working for 50 days at the rate of two shifts per day. Fifteen tonnes of pine-apple, 12

tonnes of oranges and 4 tonnes of grapes could also be processed per day during the off-season for mango.

Chaudhary *et al* (1987) reported that the total number of fruit and vegetable processing units in India were around 1,300 with an estimated production of 1.45 lakh tonnes. They noticed an increase in capacity utilization from 25 to 30 per cent in 1970 to 40 per cent in 1982. Factors like high cost of packing materials, high import duty and lack of research efforts for modernization of packaging other techniques were found to be hampering the industry's production and exports.

Mokshapathy (1988) reported that hardly one per cent of the total production of fruit and vegetables in the country was utilized for processing. About 76 per cent of processing units were small scale units including cottage and home units, 10 per cent were large scale units and the remaining 14 per cent were re-labelers.

Srivastava (1989) indicated that with subsequent secondary and tertiary processing of various raw materials, the value addition as well as the price of finished products would be increased. He observed that agro-processing units accounted for 39 per cent of all factories with 12 per cent of fixed capital, 13 per cent of working capital and 15 per cent of total capital employed in the industry in the organized sector. This 15 per cent of capital investment generated 36 per cent of the total employment, 26 per cent of the output and 21 per cent of the net value added. He noticed capital productivity in agro-industries was about the

double that of non-agro-based industries, while labour productivity was less than half when compared to non-agro based industries.

Bhat (1994) reported that infrastructure facilities required for export of agricultural products were classified into two types, namely production infrastructure and post-harvest handling. At the production level he mentioned green houses, watering systems, mechanisation of agricultural operations and post-entry quarantine facilities. Post-harvest infrastructural requirements for export marketing were shipment building, pre-cooling units, cargo facility and need-based research and development. It was also opined that identification of suitable production areas in the country was most essential. It was suggested that the government exempt duty on infrastructure required for agricultural exports. Air transportation was to be made more attractive by providing special concessional rates. Establishment of co-operative auction system on similar lines of that of Dutch system was proposed

Atteri and Puran Chand (1997) made an attempt to examine the production, consumption and processing of fruits and vegetables in India. It was observed that the consumption of fruits and vegetables had increased remarkably both in the urban and rural areas. It was estimated that in future, fruit production would result in a surplus of 7.90 million tonnes by the turn of the Twentieth Century. It would further increase to 19.67 million tonnes for fruits and 13.64 million tonnes for vegetables in the year 2005-06, after meeting the per-capita per-day requirements of 120 grams of fruits and 250 grams of vegetables and without considering

losses. Processing capacity created for fruits and vegetables increased from 0.27 million tonnes to 1.4 million tonnes between 1980 and 1994. This capacity was hardly sufficient to process 1.32 per cent of total production in 1994. Due to lack of infrastructure facilities and processing capacity, almost one-third of the total fruits and vegetables production, valued at Rs. 5,000 crores, were lost annually. This quantity would be saved through timely processing and preservation of these crops. They opined that the processing industry was being encouraged to utilize the production of these crops for generating income and employment in the rural areas. Incentives were also recommended for investment in this sector.

Pandey (2000) in his study revealed that the capacity utilisation of fruits and vegetable processing (FPO) unit was as low as about 42 per cent of the production. The results indicated that the ratio of FPO units to total production of fruits and vegetables was very low and ranged from 0.971 to 0.252. It was observed that about 95 per cent of processing units were concentrated in private sector and maximum was found in home sector (43%). The results indicated that the concentration of processing units were much higher in western regions as compared to other regions. The main constraints involved in development of processing units are lack of promising varieties, poor domestic demand, lack of technology etc.

## 2.6 Studies relating to the transportation modelling

Transportation model was used to find the optimum market for selling the farmers produce. The costs of transportation from source to selected destinations were used for finding the co efficient. Transportation models have been used for finding the optimum location, number, and size of the processing plant to meet a set of demands at the lowest cost. These location models also help in minimizing the transporting cost by optimizing transportation.

Stollsteimer (1963) worked out the models for plant number and plant locations. A model was presented with certain restrictions, and it permits the determination of the number, size and location of plants which minimizes the combined cost of assembling and processing of any given total quantity of raw material produced in varying quantities at scattered production points. The model in essence, is an extension of basic linear programming transportation model to solve for the number, size and location of plants that minimizes combined plants' and transfer costs given varying plant number and locations. The model appears to be adoptable to a wide range of empirical analysis which involved determinations either with respect to the assembling and processing of raw materials or in the manufacture and distribution of finished goods.

Warrack and Fletcher (1970) studied the plant location model, sub-optimisation for large problems, where they studied the long run spatial model which was applied to the feed industries in Iowa. Forty cities and



towns were selected as potential plant locations. A commercial mixed feed demand was estimated for each of the 99 destinations in the State. A distribution (99 X 40) cost matrix was developed. An economic engineering approach was used. The analysis was performed for single and double shift feed manufacturing operations. In each, economics of scale were detected which were reflected in respective linear homogeneous total costs functions for feed manufacturing plants. These cost functions were estimated with regression techniques.

Kloth and Blakley (1971) formulated the optimum dairy plant location with economics of size and market share restrictions. The different models to minimize the costs in assembling, processing and distribution in dairy industry were given. The results indicate that a substantial portion of savings could be attributed to the economics with the establishment of a single firm in the local markets. Using the model C (plant size environment), costs of \$ 83.80 million per month as a basis, potential saving of \$ 23.20 million per month were indicated when no plant size restriction were imposed. The plant size restrictions of model B (maximum plant size based on market share for each plant were specified) resulted in about the same number of large plants as in the model A (no plants size restriction). However, there were more plants in model B and many markets were being served by plants with monthly capacity of less than a million pounds per month. These markets were in sparsely populated areas.

Trychniewics and Tosternal (1973) put up a model for rationalizing the Canadian grain transportation and handling system on region basis. In this study, collection, handling and distribution (CHAD) simulation model was used which was the modified Stollsteimer plant location model. Here trains were used for grain transportation. The CHAD simulation model abstained from the effect of certain institutional constraints. Introduction of alternative point system made it extremely difficult to measure the impact of rationalization of farmer's collection costs.

Byrkett *et al.* (1976) studied the model for optimum location for the cattle feeding industry. The cost minimization linear programming model was developed to model the optimum location of the cattle feeding. The results indicated that feeder availability and grain availability strongly influenced the location of the cattle feeding. Roughage capacity availability was not a primary concern in the location of cattle feeding in the short run. Local use pattern that reflected both the competition for land resources and the conflict resulting from efforts to estimate problems associated with odours, solid waste disposal and water pollution in areas of high population density were important factors influencing the location.

Hugo [1981] undertook a transportation-distribution analysis of the current ration rice distribution system. The optimum location and number of public rice warehouses used in the distribution system is assessed. Results suggest that more than 50 per cent of public rice

warehouses currently used can be removed from the existing system without significant impact on transport costs. However, further reductions within the range of 25 to 13 locations tend to have increasingly greater impacts on transport costs. It is concluded that attractive benefits can be obtained from a modification of the current ration rice distribution system.

Kumbhare and Sirohi (1981) designed an application of linear programming in transportation and storage of wheat. The linear programming model aimed at minimization of costs of transportation and storage both in surplus and deficit area subject to quantity balancing equations and existing railway transportation constraints. The study revealed that the storage space requirements were directly related to assumed level of initial stocks and storage space needed to be larger in surplus states to minimize the transportation and storage costs.

Gupta and Arora (1988) conducted an experiment to minimize the cost of transportation for soybean processing industry in Uttar Pradesh wherein a transportation model was used to investigate cost minimization strategies for four soybean processing plants. The results of the study indicted that the overall total reduction of transportation cost of processing plants came to Rs.8,87,516 (12.38% in the existing transport costs), which was sizeable. The optimum plan appeared to be acceptable to all plants since its results in the reduction of transportation costs applied for all the plants.

Fukuda *et al.* (1991) used a linear programming model to investigate transport of timber from an isolated area in Kyushu, Japan. Co-operative shipment by boat, such as a roll-on roll-off ferry, is recommended (car ferry is currently used).

Vedini (1994) used the plant location model to set up the flower processing plants at different locations in Karnataka. The study suggested that the processing facilities needed to be created to encourage farmers to produce and supply the flowers to the processing plants which would ensure higher and stable incomes. The Karnataka State Finance Corporation (KSFC), while advancing the credit facilitates to set up the processing plant, was advised to see that these plants would be set up at Bangalore, Mysore, Shimoga, Bellary, Dakshina Kannada and Bijapur. In these places the infrastructural facilities for processing plants were observed to be good and had comparative advantages with regard to transport and processing cost.

Durham *et al.* (1995) developed and applied a non-linear mathematical programming model to determine the optimal allocation of processing tomatoes from the 13 largest producing counties in northern and central California, USA, to the 32 processing facilities located in the area. The mathematical model of the industry incorporates costs of hauling tomatoes from field to processing facilities and distinguishes between plants that process only bulk paste and those that process diversified products including sauces, puree, juice, and whole tomatoes. The study is also the first to incorporate explicitly tomatoes' soluble

solids content into the analysis. Results of the analysis reveal modest departures from efficiency in the prevailing tomato allocation pattern. The average one-way haul under the optimal allocation was 56.7 miles vs. 66.6 miles for the estimated actual allocation, with a resulting loss to the industry of \$22 million or 1.9% of gross profits for 1989. Simulation of entry of new processing plants in Fresno and Yolo counties suggests that new large-scale capacity plants in these locations would be among the most profitable tomato processing plants in northern and central California.

Brown *et al.* (1996) employed linear programming model to determine the optimal number of flue-cured tobacco markets for the Virginia-Carolinas region, as well as the optimal locations of these markets. The decisions were based on current market locations and county production figures. The algorithm obtained integer solutions through ascent and adjustment procedures using the dual of the linear programme. The results indicated that the 53 markets currently in existence in the Virginia-Carolinas region should be consolidated, and many of the current markets should be closed. Assuming a market-opening fixed cost of \$150 000 and a transportation cost of \$0.004/kg km, the optimal decision, based on minimizing total marketing cost, was to close 21 markets. This resulted in an annual savings of approximately \$1 665 000 (9.1%) in the total cost of selling flue-cured tobacco in this region.

Cundiff *et al.* (1997) studied several systems-related issues associated with the harvest, storage and transport of herbaceous biomass from on-farm storage locations to a centrally located processor. As a mathematical basis for designing a biomass delivery system with consideration of storage, scheduling and transportation, a linear programming model was developed for evaluating the costs of biomass transfer to a central location and for minimizing the total cost of transportation plus creation/expansion of producers' storage sites. Uncertainty in production levels due to weather was addressed by reformulating the linear program as a two-stage problem with recourse. A hypothetical county-wide case study located near Piedmont in Virginia is presented, involving 20 producers each having 4-7 storage locations, delivering switch grass [*Panicum virgatum*] as feedstock for ethanol production. Using CPLEX Version 3.1 software, the model was solved for this data set, and appropriate sensitivity analyses were conducted to illustrate the range of decision-making options available. The model minimized delivery cost by scheduling shipments from the various on-farm storage locations to meet a monthly demand of 5600 t (dry basis). Assuming the total cost of running a truck (ownership + operating + labour) to be \$500 per day, the resulting average cost of transportation ranged from \$8 to 10 /t (d.b.). The average travel distance (farm + secondary + primary roads) was found to be 22 km for delivering the 67 200 t (d.b.) required for a year-round operation.

Galvez (1999) study determined the optimum number, size, and location of livestock auction markets in Southern Tagalog and Western Visayas [Philippines] using linear programming model of cost minimization. In the analysis, the following information - livestock supply, livestock auction market locations, operating costs, transportation costs between specified pair of source and destination points in 1997 - were utilized. Results of the cost minimization model came up with five optimally located livestock auction markets in Batangas; one in Antique; three in Negros Occidental; and three in Iloilo. It showed that an excessive number of auction markets are operating at non-optimal size. The medium sized markets were found to be the optimum size of LOMs [livestock "oksyon" markets]. Contrary to government's program to put up LOMs in many areas as much as possible, the study found that such scheme was ineffective. The optimum locations identified imply that the number of LOMs in the provinces considered should be reduced. The Stollsteimer model makes it possible to know how many markets, what market size, and what locations are ideal. Considering the changes in livestock production and consumption trends, a need to estimate livestock supply and demand over a period of time may be suggested. In general, the outcome of this study points out the inefficiency of the present marketing system of livestock in Southern Tagalog and Western Visayas. Because the optimum solution was based on a number of assumptions, reliability of the optimum solution is affected by the traders' limited knowledge of updated market information, the poor market facilities that would affect operating and transportation

costs, and the inaccuracy of information obtained. Policy makers and government institutions concerned should take into account similar studies to find out how their infrastructure-related projects can be implemented efficiently so as to attain the minimum cost.

Desai (2001) used transportation model to determine the number, size and location of processing mango pulp units, which would minimize the cost of transportation and processing using linear programming model.

## **2.7 Market structure and potato marketing system**

Lele (1971) analyzed the performance of food grain marketing in India with reference to government policies. She concluded that the traditional market structure was basically competitive and fulfilled the conditions of competitiveness to a considerable extent.

Bhide *et al.* (1981) examined the market structure for arecanut in Mangalore using Lorenz curve. The study revealed a steady decline in the value of coefficient in inequality over the period. This was interpreted as an improvement in the size distribution of surveys of intermediaries in the market, which in turn increased the degree of competitiveness in the market.

SubbaRao (1984) examined market structure for FCV tobacco in Andhra Pradesh prior to introduction to auction marketing. Under the traditional marketing system farmers sold bulk of tobacco in the farm



yard and the rest in the purchasing points at the premises of the companies. The tobacco trade was by and large controlled by the private traders' characterized imperfect market conditions concentrated in rice when compared to potato and onion. In case of onion and potato the high degree of market concentration was observed. Such high degree of market concentration provides ample opportunity for price manipulations. Further the Gini ratio confirmed the extent of concentration.

Sujatha *et al.* (1989) attempted the competitiveness in the marketing of important agricultural commodities namely, rice, ragi, onion and potato at the Bangalore regulated market. The market structure was analysed using market share analysis and the method of Gini ratio. They employed the Gini concentration ratio technique to explain the extent of inequality in the distribution of volume of business among the traders. The Gini coefficient was found to be 0.33 and 0.45 for onion and potato and 0.17 and 0.21 for rice and ragi, respectively, which indicated the existence of perfect competition in the market for food grains compared to onion and potato crops.

Mundinamani *et al.* (1993) using Bain's classification of markets and the Lorenz coefficient of inequality technique analyzed groundnut markets in Karnataka. Highly and moderately concentrated oligopsonic nature of competition was observed with regard to buyers and slightly

concentrate and automatically competing type of markets with regard to sellers. A few big firms performing multiple functions controlling the major portion of groundnut trade was observed.

Dahiya and Pandey (1993) conducted sample survey of 60 potato growers in the Shimla hills region of Himachal Pradesh during 1989/90 to investigate cropping pattern, capital investment, input use, the economics of potato production and marketing. The study revealed that the market structure was competitive in Manali market but oligopolistic in Shimla market.

Nagaraja (1998) studied market structure, market share and market potential for sunflower seeds in Raichur district of Karnataka State. Theil's entropy index of 0.4638 suggests that sunflower seed market was moderately concentrated with few suppliers dominating the trade. The market share of individual brands and their switching pattern indicate that local unbranded seeds had the major share. A very high degree of brand switching was noticed among the different varieties of seeds.

Handiganur and kunnal (1999) in their analysis of market power concentration by the intermediaries revealed that the top four sellers and buyers during lean period controlled more than 50 per cent of the quantity of chickpea transacted in all the markets with the exception of Bhalki market. The results of Lorenz coefficient of inequality indicated that the high Lorenz value noticed in some of the markets was the result

of few large sized firms sharing the major quantity of produce transacted and turnover made by them. The low value of Lorenz coefficient in some markets inferred that marketing system of chickpea was most competitive which is evident from the fact that arrivals in the market is distributed among more number of intermediaries. The rejuvenation of cooperative societies by linking of credit with marketing and establishment of Karnataka Pulse Growers' Federation would go a long way in avoiding the concentration of produce in the hands of few traders.

Sankaranarayanan and Padmanaban (1999) identified the market structure of pesticides at retail level as oligopoly. The single firm concentration ratio and eight firm concentration ratio was 17.21 per cent and 56.89 per cent respectively, implying that the major share in pesticide sales was concentrated with few dealers. There were 49 dealers to cater to the plant protection chemical needs of 7,888 farm holdings indicating large number of buyers. There were maximum number of dealers (13) in Keela Tiruchendur and maximum number of farm holdings in Kayamozhi, indicating the weak association between these factors. Based on brand name, symbol, colour of the packing material offered by the firms, the farmers were able to discriminate the pesticides. Competition between the existing retailers in retaining the market share and high initial investment act as barriers to entry.

## **2.8 Export competitiveness of major agricultural commodities**

To assess the export competitiveness of Indian mangoes and processed mango products in the international market Normal Protection Co-efficient (NPC), Domestic Resource Cost (DRC) analysis was used. Application of technique in other studies has been discussed.

Anderson and Ahn (1984) examined the protection policy and changing comparative advantage in Korean agriculture from the mid-1960s. The domestic resource cost methodology was used to measure the foreign exchange earnings foregone by keeping resources in rice production. They concluded that agricultural protection was unlikely to continue to achieve its objective of slowing the decline in food self sufficiency and helping farmers keep pace with urban incomes unless it was increased continually.

Jamal (1987) examined the cotton pricing policies pursued by the Pakistan Government and the nature of its intervention in cotton trade and quantified the effects of price distortion over the period 1977-78 through 1982-83. Support prices were found to be closer to revenue maximization prices than to the border prices adjusted to farm gate level. Two distinct phases in the trends of NPC's indicated the government's divergence in maximising foreign exchange in earlier years to revenue maximisation in later years.

Gulati (1987) attempted to quantify the degree of distortion in trade pricing policies with regard to Indian seed cotton (kapas) during 1980s.

The region and variety specific structure of incentives for cotton was estimated by adopting a standard methodology covering four major varieties of cotton, which dominate in the cultivating regions of Maharashtra, Punjab, Gujarat and Andhra Pradesh. The results in general indicated a situation of disprotection for the Indian cotton cultivators and suggested that Indian cotton is an efficient export crop as well as an efficient import substitute.

Umapathi (1994) estimated export competitiveness of cotton in Chitradurga district. The nominal protection coefficient computed for DCH-32 cotton from 1983-84 to 1991-92 under exportable and importable hypothesis indicated an overall situation of antiprotection to cotton cultivation in the study area. The nominal protection coefficients were found lower than one and implied that DCH-32 seed cotton would be an efficient export as well as an efficient import substitute crop.

Maji (1996) estimated the Nominal Protection Co-efficient (NPC) for Indian rice to be less than one indicating potential benefit from export to obtain benefit of the higher international price. The Effective Protection Coefficient was also less than one indicating that rice producers were not protected through policy incentives. Similarly Domestic Resource Cost rates, which were less than one, implied that a low domestic resource cost could earn a much higher value in foreign exchange through export.

Reddy (1997) worked out the Nominal Protection Co-efficient (NPC) of groundnut, maize, jowar and sunflower in Karnataka. The NPC of

jowar and maize under the importable scenario was less than one indicating that they were efficient import substitutes and their NPC under exportable scenario was greater than one. Whereas, the NPC of groundnut and sunflower under importable and exportable scenario were greater than one, reflecting that, they were neither import substitutes nor efficient exportable commodities.

Ravi and Govinda Reddy (1998) used nominal protection coefficient technique to workout the export competitiveness of jowar, maize, groundnut, sunflower, cotton and coffee from Karnataka under the importable and exportable hypothesis for a period of ten years from 1984-85 to 1994-95. The results revealed that among the six commodities, Karnataka lacked comparative advantage in most of the crops except cotton. The export potential of jowar, maize, groundnut and sunflower were found to be significantly low.

Vinu Viswanath (1998) studied the competitiveness of rice in Karnataka during the year 1990-91 to 1994-95. The NPC and DRC were estimated under importable and exportable hypothesis and results indicated that the NPCs for fine and medium quality rice was the highest compared to other zones. The NPC for fine and medium quality rice in Hilly Zone (HZ) was 0.69 and 0.62 respectively, which were the lowest compared to other zones. The NPCs were below unity in all zones and thus indicated that the wholesale prices of rice were below the international prices of rice and domestic rice was an efficient import substitute. The DRC ratios were more than unity under importable hypothesis for both the quality of rice in Northern Dry

Zone (NDZ), i.e., 1.58 for fine and 1.48 for medium rice and same in Southern Dry Zone (SDZ), 1.3 for medium and 1.4 for fine. This indicated that NDZ and SDZ had to spend more than Re.1 to earn one rupee of foreign exchange. So it was not profitable to use non-tradable inputs in the production of rice in the zones whose DRCs were greater than one.

Tamanna *et al.* (1999) examined the export potentialities of fruits from India by using nominal protection coefficient, which is the ratio of domestic price to the border price. On an average, the nominal protection coefficient value in mango (0.87), grape (0.59) and banana (0.49) were lower than one indicating their competitiveness in international market.

Ashalatha (2000) analysed the export competitiveness of Indian cashew using nominal protection coefficient technique. Under the exportable hypothesis the nominal protection coefficients were found to be lesser than unity with an average value of 0.91, implying that the Indian cashew kernel is competitive in the international market and is an efficient export commodity.

Balappa Shivaraya (2000) studied the export competitiveness of Indian fresh vegetables using nominal protection coefficient technique. The results of the study revealed that all the vegetables considered-onion, potato and tomato were competitive for their exports to other countries, since the nominal protection coefficient values were less for all.

Mahesh (2000) studied the export competitiveness of Indian tea exports using NPC and DRC methodology. The results indicated that

under importable hypothesis, the NPC and DRC were 0.71 and 0.66 respectively and under exportable hypothesis, the NPC and DRC were 0.98 and 0.93 respectively, implying that Indian tea exports were competitive and also good import substitute.

Jayesh (2001) examined the export competitiveness of pepper using NPC. The nominal protection coefficient of less than unity (0.817 for Sirsi and 0.849 for Calicut) indicated that pepper was competitive for its export to other countries from Sirsi (Karnataka) and Calicut (Kerala) markets.

Kumar *et al.* (2001) concluded that exports of potato from India have been fluctuating and was quite negligible compared to the total potato production. The NPC for potato is largely above one (1.23) when the Official Exchange Rate (OER) is used while it's below one (0.97) when Shadow Exchange Rate (SER) is used, indicating moderate export competitiveness.

Ali and Ahmad (2001) studied the export competitiveness of Indian meat industry. They concluded that export of ovine meat is constrained due to increased domestic demand resulting in higher domestic prices. The export of poultry meat is not competitive due to higher cost of production and higher domestic prices. Only bovine and pig meat is competitive in the global market. The potential reforms in the international trade policy and implementation of WTO norms will reduce restrictions on trade and protection of domestic meat industry. This may



bring new global competitive environment under free trade regime. India may enjoy greater competitiveness for different species of meat as producer prices in India are lesser as compared to other major countries of the world.

### **2.8.1 Structural changes and direction of trade in exports**

Markovian analysis can be employed to find the structural changes in any system whose progress through time can be measured in terms of single outcome variable. By using transitional probability matrix, we can predict the demand for future years also.

Atkin and Blandford (1982) studied structural changes in import market shares for apples in U.K. The changes in composition of U.K. apple imports during the period 1963-74 were analysed using a first order Markov model. The study indicated that changes in market share had been systematic, stable and of long duration. The estimated transitional probability matrix could explain the nature of change by indicating the relative competitive strength of different exporters. The large increase in France's market share was examined and estimate derived on the effect of U.K. membership of the E.C for the year 1978-79. The results showed that E.C membership increased French market share in the U.K. market by more than 26 per cent points and decrease the share of Australia and South Africa by 18 and 10 percent points respectively.

Buckwell *et al.* (1983) examined the changes in the size structure of the dairy industry in Scottish Milk Marketing Board (SMMB) area. The projected sex distribution of dairy herds was combined with sample projections of average herd size and yield, which indicated the outlook of milk production during 1980s. This suggested that secular increases in SMMB milk production might be slowing down and could even come to an end during next few years.

Erthridge *et al.* (1983) studied the changes in the structure of Texas high plains cotton ginning industry using Markov chain procedures. Future industry structures were made under conditions of transition probabilities. All projections showed declining number of active ginning firms with large decline in number of small firms and increasing number of large firms.

Fialor (1985) analysed the market share of Ghanaian cocoa exports for the period of 1951-81 using the Markov model. He decomposed the total change in export into the overall market share effect, the direction of trade effect, and the individual market effect. It was observed that there was an overall contraction in Ghana's cocoa exports during this period to the tune of about 38,000 tonnes. Even though there was an expansion in exports due to increase in the overall market share effect as a consequence of increased world demand to the extent about 2,26,000 tonnes and another 15,000 tonnes due to the direction of trade effect; yet the loss through the individual market share effect was large, 2,78,000 tonnes and this had resulted in the contraction of Ghana's export.

Srivastava and Ahmed (1986) analysed the direction of exports from India for the period 1960-61 to 1983-84. The countries such as U.S.A., former U.S.S.R., U.K., Japan and erstwhile West-Germany had greater share in India's export and import trade. India's exports to the above mentioned five major trading countries declined over the period of study. The U.K. no more remained as the principal destination of Indian trade as it was in the pre-independence period. In 1983-84, U.S.A. emerged as one of our major trading partners.

Durham and Lee (1987) analysed the changes in exporter market share in the Kuwait's poultry import market over the period 1971-81 by three modeling procedures. Two traditional approaches, a first order constant transition probability Markov model, and a set of market share equations were found to be of only limited use. As an alternative, a multinational logic model of market share behaviour was estimated. The empirical results indicated that, in addition to relative price changes, domestic policy inducement for Britain and European community exports were important in determining market share changes.

Wilson *et al.* (1990) studied importer loyalty in the international wheat market. The results revealed that, in general, the United States of America had relatively strong importer loyalty, compared to other exporters such as Canada and the European community.

Gemtessa (1991) analysed the direction of coffee trade using a Markov Chain model. The share of Ethiopian coffee export to the US had

drastically declined during the years 1979 to 1989. The loss in the export share of Ethiopian coffee to US, France, USSR and other countries were directed to erstwhile West Germany. The study revealed that the Ethiopian coffee exports to Japan, France and Italy had moderately increased while the share to Saudi Arabia remained stagnant. It was predicted that the market share of Ethiopian coffee exports to West Germany would increase to 32 per cent by 2000 AD, mainly because of their preference for Ethiopian coffee.

Veena (1992) analysed the direction of Indian coffee exports in terms of importing country shares over the period 1965-90 using Markov Chain analysis. The projections indicated a declining trend in Indian coffee exports to the USA, Yugoslavia, Netherlands and other importing countries. The increased market shares of the erstwhile USSR in the 1970s and 1980s were subsequently threatened by economic and political upheavals in the region.

Jeromi and Ramanathan (1993) noticed significant changes in the direction of pepper exports from India for the period 1975-90. It was observed nearly 44 per cent of India's pepper exports were directed to the former USSR, which constituted about eighty two per cent of the total pepper imports of that country. On the other hand, India not only failed to increase its exports to USA in tune with increased consumption in that country but also could not sustain the quantity exported during the earlier years. Instability was low in case of exports to former USSR, Italy and Canada and higher for Poland, USA and Czechoslovakia.

Laxminarayana (1993) studied the direction of Indian silk exports by following first-order Markov process. The major importing countries considered for the analysis were USA, West Germany, UK, France, Italy and Japan. The exports to USA were stable and would remain highly loyal to Indian silk. The probability of export to the UK, West Germany and Japan switching over to USA was unity implying that, entire quantity of exports to these countries would drift to USA over a period of time.

Jalajakshi (1994) study showed the changing pattern of Indian shrimp exports between two periods, Period-I covering the years 1970-80 and Period-II covering the years 1980-90. The study indicated that during Period-I, India could not retain its previous market share in the EEC countries. Nearly, 90 per cent of Indian share was diverted to Japan and seven per cent was diverted to UK. However, in Period-II, India could retain 11 per cent of its previous market share in the EEC countries due to the gradual acceptance of tropical shrimps in these countries.

Veena *et al.* (1994) examined the changing directions of Indian coffee exports in terms of importing country shares over the period 1965 to 1990 using Markov chain analysis. It was observed that India could not retain its previous market share to USA, Netherlands, Yugoslavia and other importers. However, the actual quantity exported to all these countries has increased which was due to increased quantity of Indian coffee exports. India retained its market share to former West Germany, erstwhile USSR and Italy. The increased market share of USSR in the

1970s and 1980s was then threatened by the economic and political upheaval in the region.

Diana (1997) used non-stationary Markov chain analysis to explore the linkages between sector specific policy and sector employment in Oregon, USA. Application of the technique to Oregon's forestry sector and national forest policy demonstrates that macroeconomic forces had statistically important effects on employment while national forest policy, measured as timber sold or timber cut does not. This result raises question about forest policy impact analysis and assumptions inherent in national forest policy implementation.

Nagaraja (1997) analysed the direction of trade of the Indian horticultural commodities exports by employing a first order Markov process which helped in identifying the gains and losses in export value. It revealed that the other fresh fruits, vegetables and processed fruits and vegetables export retained their share of 56.7 per cent and obtained 68.5 per cent and 24 per cent of onion and garlic respectively. Where as grapes, onion and mango juice sustained their original share of 59.8 per cent, 19.4 per cent and 49 per cent respectively.

Ajjan *et al.* (1998) analysed the direction of trade of senna and periwinkle in India using Markov Chain analysis. The probability of Germany and U.S.A. retaining their import shares in the years (Senna) to come were estimated to be 0.8258 and 0.8188, which clearly indicated that these two countries would retain their import share in the same

position as 1977. For periwinkle, France had a high retention of the export share (probability of 0.8826) while Germany and others had as low as 0.2644 and 0.0543, respectively. This clearly indicated that the chances of maintaining export share to France was 88.26 per cent and in the other two cases the chances of maintaining the export share was practically low or nil for the year 1996.

Mandanna *et al.* (1998) analysed structural change in India's tobacco exports for the period 1980/81-1994/95 using Markov chain analysis. The study reveals that the USSR, the largest market for Indian un manufactured tobacco, showed a high degree of loyalty for Indian tobacco during the period 1980/81-1985/86, but that this diminished substantially during the period 1985/86-1994/95. The markets of Western Europe, Asia and the Middle East have taken the place of the USSR. Among the manufactured products, only cigarettes had a dominant presence in the export basket. The diversification of export markets is clearly evident, necessitating efforts in the direction of brand building for Indian tobacco. The Tobacco Board of India can initiate this exercise. Measures should also be initiated to improve the export competitiveness of Indian tobacco in the world market.

Srinivasamurthy and Subramanyam (1999) analysed the direction of onion trade by using Markov chain model during the year 1980-81 to 1994-95. The major gainer among importers of Indian onion over a period of time was Malaysia which was having a transfer probability of 0.6459 from Saudi Arabia and 0.3488 from UAE, Sri Lanka, in addition to having

high probability of retention of its own share, was also likely to gain from Saudi Arabia with a moderate probability and gain of 0.3488. On the other hand, Saudi Arabia which was having zero probability of retention of own share of exports of fresh onion was likely to gain to some extent from Bangladesh and other countries.

Murthy and Subramanyan (1999) measured the dynamics of changes in the exports of Onion from India to different countries with the help of a Markov Chain model. From one step transitional probabilities the model was extended to n-step for future forecasting. The results have shown that Malaysia, UAE and Singapore had high probability of retention and would well continue to be the major importers in the future also. As revealed by the low values of probability of retention, Saudi Arabia and others were unstable importers of Indian onion. In the next decade, Sri Lanka and Bangladesh were likely to increase their imports from India though it would come at the cost of exports to the UAE.

Balappa Shivaraya (2000) studied the changes in trade directions of export of selected vegetables using Markov chain analysis. The results of the study revealed that UAE and Malaysia were the loyal markets for Indian onion. In case of potato, Sri Lanka and Nepal were found to be the most loyal markets whereas; Bangladesh and Nepal were the most stable importers of Indian fresh tomatoes.

Mahesh (2000) analyzed the structural changes in Indian tea exports by employing the first order Markov model. The transitional



probability matrix indicated that the countries like United Kingdom, USSR, Iran, U.A.E. Saudi Arabia and other importing countries retained their previous shares of Indian tea while rest of the countries like Germany, Poland and U.S.A. could not retain their previous shares of Indian tea.

Angles *et al.* (2001) used markov chain model for assessing the direction of trade and destination for Indian turmeric. The results of markov chain analysis showed that pervious export share retention for Indian turmeric was high in UK (42.99 per cent) and countries pooled under others category (58.77 per cent). The countries such as USA, Iran, Japan and UAE were not stable importers of Indian turmeric. The plans for export may be oriented towards these two and also plans should be formulated for stabilizing the export to other countries.

Desai (2001) used Markov chain model to analyse the trade direction of export of Indian fresh mango and mango products. Japan was one of the most stable countries, among major importers of Indian fresh mango as reflected by its high probability of retention (1.00). In the case of mango pulp, other countries had the highest probability of retention (42.90%) followed by Saudi Arabia (24.00%) while, Netherlands, UK, Kuwait and UAE were unable to retain their share as reflected by their probability of retention of zero. The transitional probabilities estimated for mango slices in brine showed that UK was the most stable country among major importers of Indian mango slices in brine as reflected by its high probability of retention (0.782).

Jayesh (2001) used Markov chain analysis to study the direction of trade and changing pattern of pepper and cardamom exports from India. The results of Markov chain analysis indicated that our exports of pepper are likely to be concentrated in USA and Russia. Similarly cardamom export is likely to be concentrated in Japan and Saudi Arabia. A high dependence on one or two export markets would increase the trade risk in the long run. Hence appropriate export promotion strategies are to be evolved to diversify the geographical concentration. Especially in case of cardamom exports, steps should be taken to enhance our exports to other countries of Middle East along with Saudi Arabia, since this region is the major consumer of cardamom in world.

### **2.8.2 Studies relating to the export constraints and export potential**

Islam Nural (1990) mentioned that the entry of horticultural products into export markets was constrained due to the lack of specialized nature of export- related infrastructure, including strict quality and sanitation standards as well as established consumer preferences for specific products in particular markets. The author concluded that the organization of an effective system of packing, processing, storage, transportation and distribution, both nationally and internationally, was crucial to success in horticultural exports.

Dahiya and Bhatia (1992) examined the trends, status, constraints and export potential of India's potato exports and suggested a future strategy. Whilst total domestic production expanded at a relatively fast

growth rate, between 1971/72 and 1986/87, potato exports recorded a negative rate of growth over the same study period. An analysis of India's export potential (comparative productivity, fulfilment of domestic demand and potential market availability) indicates that the country has an economic advantage in exporting the crop. However the lack of refrigerated transport and storage facilities required to market potato is a major constraint, as is the inability to provide producers with high-quality seed. These are both manifestations of the absence of a long-run, integrated, consistent export policy. The paper recommends the establishment of a national Potato Marketing Board responsible for the development and marketing of the potato both for domestic and export markets.

Chakrapani (1994) reported that no attention had been paid to develop the export of fruits and vegetables. During 1992-93 fruits and vegetables worth Rs.203 crores were exported from India mainly to U.A.E. and U.K. These products, being perishable, needed proper attention at all stages right from farm to the selling outlet. But, unfortunately sufficient attention had not been paid in this direction.

Subramanyam (1994) stressed that the production constraint is one of the important constraints affecting the export potentialities of horticultural products. He noted that other important constraints were low productivity, lack of suitable varieties for processing, pests and diseases, extreme shortage of supply of quality materials and non-availability of technical information on the aspects of post-harvest

handling. Regarding infrastructural facilities, he noted that there was a lack of storage facilities, pre-cooling chambers, packing, refrigerated transport and expensive air cargo freight. He also estimated that nearly 30.00 per cent of produce was lost through inadequate knowledge of harvesting, handling, packaging, transport and storage.

Vyas (1994) suggested the following preconditions in order to increase exports of fruits, vegetables, flowers, etc., (a) vertical integration of small holdings with appropriate secondary and tertiary organizations for input supply, quality control, marketing and processing, (b) the infrastructure support in terms of communication, transport, cold storage etc., (c) development of economic and social infrastructure, for example, adoption of banking facilities, pricing policies and development of appropriate information system.

Singh (1995) studied the post-harvest technology of mangoes and observed that, in order to export fresh mangoes there was an urgent need to adopt a host of measures. These were listed as adoption of modern innovations in post-harvest technology such as harvesting at optimum maturity, washing, cleaning, waxing, fungicidal treatment, size and colour grading, sorting of fruits according to their varietal characteristics (using automatic, mechanical and electrical machines), removal of damaged, defective, diseased, pest-attacked fruits, packing in ventilated CFIS cartons, pre-cooling and cold storage at the prescribed temperatures and relative humidity, transportation in well-aerated and cooled in wagons, trucks (for domestic markets ) and in reefer containers

for distant export markets by ship and air cargo, delivery within the time schedule, price and quality and strict adherence to phytosanitary standards.

Srivastava *et al.* (1996) reported that although India was a major producer of a number of delicious varieties of mangoes, it exported only one or two varieties including Alphonso of Maharashtra on a large scale. They observed that the incidence of spongy tissue in Alphonso and fruit-fly and stone weevil in Banaganpalli and Dashehari varieties acted as a constraint in the export of fresh mangoes. Lack of uniform size and colour among mango fruits also impeded their export. Indian mangoes could not be exported to U.S.A. and Japan, which were big consumers because of their strict quarantine laws which required vapour treatment of the fruits. Export of mangoes by air made it costlier due to higher air freight rates.

Gopal Rao (1998) studied the export of horticultural crops from Andhra Pradesh and observed that mangoes and onion were exported in large quantities to foreign countries. The major constraints in the way of increasing export of fruits and vegetables to international markets were poor quality, premature harvesting of the fruits leading to reduced shelf life and low sugar content, lack of adequate knowledge on packing methods and techniques, lack of knowledge of the quality standards in international marketing by both farmer as well as the merchant, poor storage and transport facilities, carelessness in handlings of fruits and vegetables at various stages of picking, packaging and transportation.

Thus, the author opined that for the promotion of export of fruit and vegetables in the state, dissemination of knowledge on international standard of quality, export policies, duties, subsidies and taxes, freight, etc. was essential to all, from growers to the exporters. Strict supervision and control on the maintenance of quality for export was essential.

Praduman Kumar *et al* (1998) stated that, despite wide variety of fruits and a comparative advantage in their production and export, India has not been able to do well on the export front. The main reasons which are preventing the field to grow are high costs of raw material due to low yields, variations in the quantity and quality of the raw material, due to small production units, inadequate and expensive refrigeration facilities for storage, transportation and distribution, poor availability and high costs of quality packaging and related machinery and inefficient technologies. To strengthen this activity the study suggested to diversify and expand the export basket paying due emphasis on the development of domestic markets and infrastructure facilities simultaneously.

Nawadkar and Birari (2000) assessed India's share in production and export of fruits and vegetables. India shared 43.53 per cent and 52.62 of per cent to the world production of cauliflower and mangoes respectively. The contribution made by the country with respect to onion and bananas was also considerable. The fruits and vegetable exports at the end of 1997-98 were valued to 772.48 crores of which 60 per cent was contributed by fruits and remaining 40 per cent by vegetables. Among these, export of cashew nuts and onions occupied 5 neighboring markets as well as gulf markets. However, there is a vast scope for

increasing exports to distant markets. In spite of the potentialities in production base, India's export of fruits and vegetables is not encouraging due to higher taxation, poor quality, lack of infrastructure, export promotion activities and research and development and there is a need to link production with export.

Jadhav *et al* (2000) studied on marketing of cut flowers and export potential of floriculture in Karnataka, Tamil Nadu and Andhra Pradesh which contribute much in terms of area, and production of floriculture in the country during the years 1993 to 1996. Japan, Netherlands and USA are the countries leading in the business of floriculture in terms of area and output in the world in the same period. The European countries are having the maximum demand for the cut flowers, flower buds and dried flowers. In the domestic market transportation was the highest marketing cost for cut flowers (rose, gerbera, gladiolus, etc.), while for aster it was retailer's expenses. In the case of price spread, as the number of intermediaries in the marketing of selected flowers increases, the producers' share in consumers' rupee decreases

Leela (2000) opined that a plan of action and strategy has to be developed to increase the production of aqua species, which can be processed and exported on a large scale. It is essential to bring about diversification of marine export products, improve infrastructural facilities and maintain international quality standards along with eco-friendly practices, in order to fully exploit the marine export potential of the State. This should be the major thrust of the marine export policy of the State of Andhra Pradesh in the new Millennium.

## *Methodology*

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### **III. METHODOLOGY**

In this chapter, a comprehensive view of the methodology adopted for the investigation viz., the study area, source of data and analytical techniques used are presented.

#### **3.1 Description of the study area**

Karnataka is the eighth largest state in India and it is situated between 110° 3'N and 18° 45'N latitudes and 74°12'E and 78°40' E longitude, in the Western part of the area known as the Deccan Peninsula. The state has an area of about 1.92 lakh square kilometres. Goa and Maharashtra in the north, Andhra Pradesh in the east, Tamil Nadu and Kerala in the south and Arabian Sea in the west surround the state. The state has a varied topography ranging from the narrow coastal plain abutting the high ranges of the Western Ghats to plains in the east. A greater part of the state lies between the elevations 450 meters and 900 meters above the Mean Sea Level. The elevation however, exceeds 1800 meters in the Western Ghats region of the state. The state has a population of about 44.97 million (1991 Census) with a population density of 235 persons per square kilometre. Figure 3.1 depicts the agro climatic zones of Karnataka.

Rainfall is bestowed on the state from both the South-West and North-East monsoons. The annual rainfall ranges from 466.5 millimetres

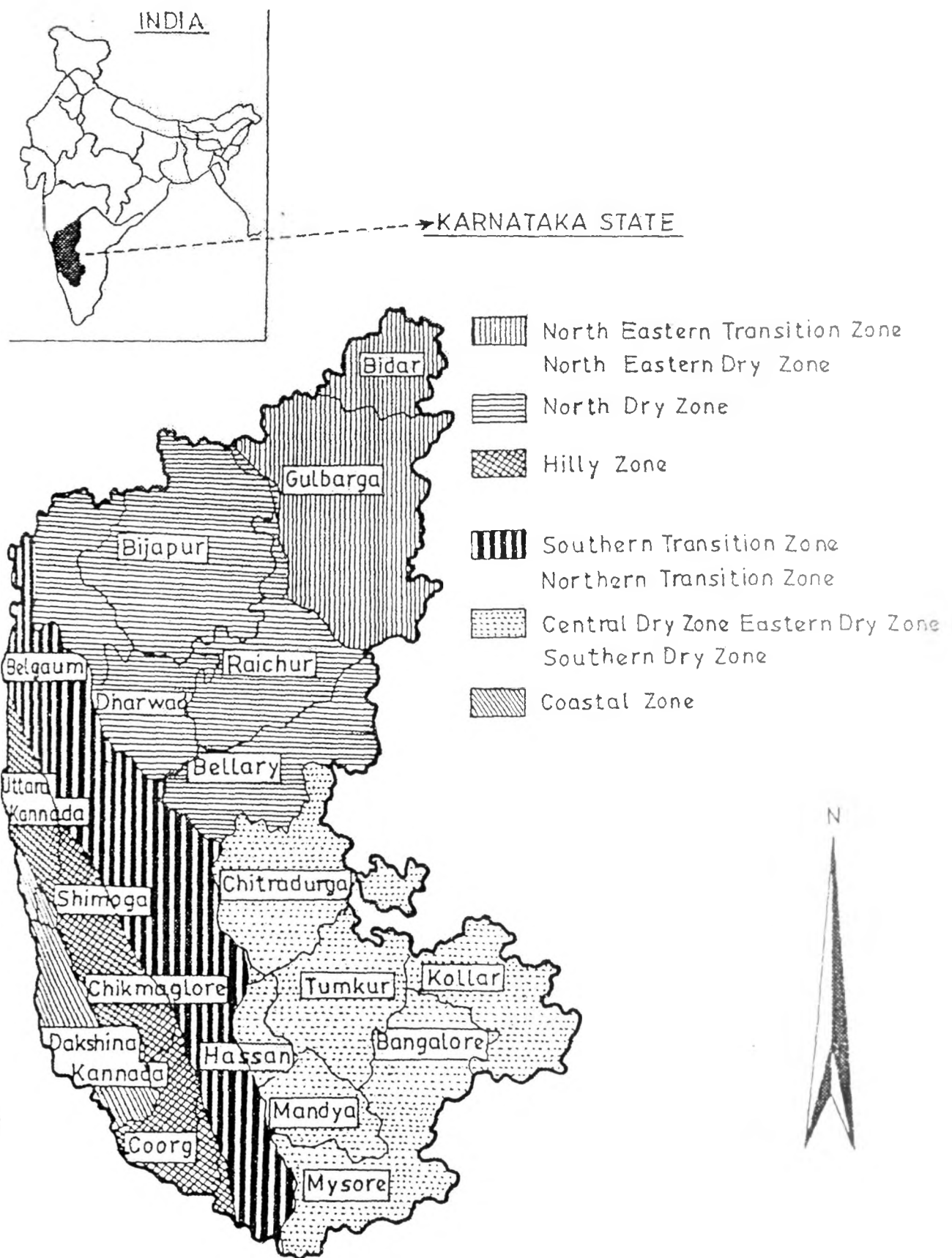


Fig.31. MAP OF KARNATAKA STATE SHOWING AGRICULTURAL ZONES.

to 4694.4 millimetres. The South-west monsoons account for 73 per cent of the total annual precipitation. The average number of rainy days varies from 40 in the eastern Chitradurga area to 123 days in the coastal areas. Rainfall data over the years indicate about 63 per cent of the total geographical area of the state receives relatively low rainfall with frequent dry spells and the agricultural productivity in this area is very unstable.

The mean minimum temperature is 17.5 °C. The minimum temperatures range is 20.3°C in the coastal areas to 14.3°C in the interior. The maximum temperature range is 42°C in the northern Bidar-Gulbarga region and it declines progressively proceeding towards the south-western parts such as Agumbe, where it is 28.3° C. Depending on the availability of moisture, the weather and soils of the state permit almost year-round cropping except in a few locations.

Potato is predominantly grown in five districts of Karnataka namely; Bangalore, Belgaum, Dharwad, Hassan and Kolar and these districts were selected for the study. Five markets based on the volume of arrivals were selected for detailed analysis.

### **3.2 Database and sampling procedure**

The present study is based on both primary and secondary data sources. The districts were selected based on the area under potato for the year 1999-2000 and the same is presented in Table 3.1. The secondary data obtained from Department of Horticulture was used to delineate the study area.

**Table 3.1. Area and Production of potato in major districts of Karnataka  
for the year 1999-2000**

| Sl. No. | District      | Area<br>(Hectares) | Production<br>(Tonnes) |
|---------|---------------|--------------------|------------------------|
| 1.      | Hassan        | 12910              | 118404                 |
| 2.      | Belgaum       | 10390              | 109405                 |
| 3.      | Kolar         | 7895               | 143690                 |
| 4.      | Dharwad       | 4539               | 53552                  |
| 5.      | Bangalore (R) | 2974               | 59480                  |
| 6.      | Bangalore (U) | 758                | 17817                  |
|         | State Total   | 39466              | 502348                 |

### **3.2.1 Selection of farmers**

A multistage random sampling frame was employed for the selection of sample farmers. In the first stage the top five districts having highest area were selected for the study. From each district two leading taluks were selected based on area under potato and from these taluks two villages in each were selected. Again from each selected village five farmers cultivating potato were randomly selected, thus the total sample size was 100 farmers.

### **3.2.2 Selection of Markets**

Based on the volume of arrivals, six markets Viz., Bangalore, Belgaum, Chikkaballapur, Hassan, Hubli and Kolar were selected for detailed analysis.

### **3.2.3 Selection of commission agents**

From each selected market, 10 potato commission agents were randomly selected, thus the total sample size was 60 commission agents.

A cross section of transporters and traders involved in the potato trade were also interviewed.

### **3.2.4 Data**

The primary data were collected from potato growers by personal interview using structured pre-tested schedules. The data collected pertained to agricultural year 2000-01. The data collected from the

farmers included socio-economic characteristics of the farmers, their land characteristics and cropping pattern; details of their potato cultivation including area, varieties, yields, establishment and maintenance costs of machinery and storage structures, marketing problems and transportation costs etc. The pre-tested questionnaire was used to find out the constraints faced by the farmers in the production of uniform quality potato and marketing of produce.

The data pertaining to the various aspects under study were collected from the following secondary sources.

- 1) Directorate of Horticulture, Lalbagh, Bangalore
- 2) Selected Agricultural Produce Marketing Committees (APMCs)
- 3) Karnataka State Agricultural Marketing Board (KSAMB)
- 4) Karnataka State Co-operative Marketing Federation (KSCMF)
- 5) Agricultural and Processed Products Export Development Authority (APEDA)
- 6) Karnataka State Agricultural Produce Processing and Export Corporation Limited (KAPPEC)
- 7) National Horticultural Board (NHB)
- 8) Directorate General of Commerce, Industries Statistics (DGCIS)

To analyse the growth in arrivals and prices, seasonality in arrivals and prices and to assess market integration, data were collected for the period from 1990-91 to 2000-01 from the selected APMCs. To evaluate the financial feasibility of cold storages, data were collected from KSCMF. To examine the growth pattern, competitiveness and trade directions of exports, data regarding country-wise export of potato from India were collected for the period from 1992-93 to 2000-01 from APEDA and DGCIS.

The information relating to project estimates on the establishment costs of cold storage plants was collected from Karnataka State Cooperative Marketing Federation (KSCMF). The data on the investments required for developing additional infrastructure facilities such as processing, storage and transportation was generated by interviewing the existing agencies in the market hinterland.

### **3.3 Analytical techniques**

The details of methods of analysis followed are presented as under:

3.3.1 Exponential method

3.3.2 TCSI model

3.3.3 Market integration

3.3.4 Project analysis techniques

3.3.5 Markov chain analysis

3.3.6 Nominal protection coefficient (NPC) and domestic resource cost (DRC)

3.3.7 Linear programming model

3.3.8 Simple tabular analysis

### 3.3.1 Analysis of growth rates

Growth of any variable represents its past performance. The analysis of growth is usually used in economic studies to find out the trend of a particular variable over a period of time. It clearly indicates the performance of the variable under consideration and hence it can be very well used for making policy decisions.

The trends in arrivals and prices of potato in major market of Karnataka were estimated by using the exponential growth function (Veena *et al.*, 1995) of the form.

$$Y_t = ab^t u_t \quad \dots(3.3.1.1)$$

Where,

$Y_t$  = Dependent variable for which growth rate was estimated

$a$  = Intercept

$b$  = Regression coefficient

$t$  = Years which take values 1, 2, . . . . .  $n$

$u_t$  = Disturbance term for the year  $t$



Equation 3.3.1.1 was transformed into log linear form as follows

$$\ln Y = \ln a + t \ln b + \ln u_t \quad \dots(3.3.1.2)$$

Equation 3.3.1.2 was estimated using Ordinary Least Square (OLS) technique. The compound growth rate (g) in percentage was then computed from the relationship,

$$g = (\text{Antilog of } \ln b - 1) \times 100.$$

The significance of the regression coefficient was tested using the student's 't' test.

### **3.3.2 Trend and seasonal movements in arrivals and prices**

In order to study the trend and seasonal movements in arrivals and prices, Time-series analysis (ratio to moving average) was adopted. The time - series data were used for studying the time series components mainly trend, seasonal, cyclical and irregular fluctuations (T, C, S and I). The 12-month centred moving average was computed. Under this method, there are two models namely Additive model and Multiplicative model. The multiplicative model was preferred to the additive model for analysing the trend and seasonal movements in arrivals and prices of potato (Girish 1995). In the multiplicative model, hypothesis is that the components are linked together in a multiplicative fashion as

$$O = T \times C \times S \times I$$

Where,

95

O = Original data

T = Trend

C = Cyclical

S = Seasonal

I = Irregular

The seasonal factor is obtained as follows:

$$S = \frac{O}{M}$$

Where,

M = Twelve-month centred moving average

Seasonal index is obtained as follows.

$$S^* = S \times 100$$

The seasonal index so obtained was used to eliminate seasonality from the original data by dividing original data by the corresponding month's seasonal index. This gives the final estimates of the remaining components namely trend and cycle.

$$\frac{O}{S^*} = T \times C$$

### **3.3.3 Market integration**

The study of market integration determines the relationship between the prices in the two markets that are spatially separated. Spatial price relationships have been widely used to indicate overall market performance. Integrated markets are those where prices are determined interdependently. In order to study the market integration the analytical technique used was simple correlation (Bhatta and Bhat, 1988). Correlation matrices of different market prices were worked out to know their integration. If two markets are perfectly competitive and well integrated spatially, the correlation coefficient between a pair of such time series data on prices will be equal to unity. Any lack of market integration is indicated by the correlation coefficient that is lower than unity.

### **3.3.4 Project analysis techniques**

Discounted cash flow technique was used to evaluate the financial feasibility of investments.

The discounted cash flow methods of evaluating long term projects is based on the fact that a rupee invested today is worth more than a rupee in future years. It is a process of finding the present worth of an amount paid or received in future. This technique has an advantage that future cash flows are reduced to a single sum at one specific point of time, which facilitates comparison between alternative choices, if any. The Net Present Value (NPV), Benefit-Cost ratio (BCR), Pay Back Period

(PBP) and Internal Rate of Return (IRR) were estimated to find out the feasibility of investment. Further, sensitivity analysis was also carried out to find out the sensitivity of investments to the risks of increase in costs or decrease in returns or both together.

### 3.3.4.1 Net Present Worth (NPW)

This criterion assesses the present worth of accrued benefits over costs. The criterion ranks the investments for selection among the alternatives as well as indicating the order of preference to be given. In calculating Net Present Worth, the differences between present value of cost streams and present value of benefit streams were considered at a discount rate of 10 per cent. The general mathematical form of net present worth criterion is as follows.

$$NPW = \sum_{t=1}^n \frac{B_n - C_n}{(1+r)^n}$$

Where,

$B_n$  = Benefit in year  $n$

$C_n$  = Cost in year  $n$

$n$  = Number of years

$r$  = Discount rate

The Net Present Worth has to be positive to indicate that the project investment is financially sound.

### 3.3.4.2 Benefit Cost Ratio (BCR)

Benefit cost ratio is the ratio between discounted cash inflows and discounted cash outflows and the ratio must be unity or more for an investment to be considered worthwhile. Mathematically, it can be stated as:

$$BCR = \frac{\sum_{t=1}^n \frac{B_n}{(1+r)^n}}{\sum_{t=1}^n \frac{C_n}{(1+r)^n}}$$

Where,

$B_n$  = Benefit in year n

$C_n$  = Cost in year n

n = Number of years

r = Discount rate

### 3.3.4.3 Pay Back Period (PBP)

Pay back period (PBP) indicates the time period a project takes to return the initial investment and is given by:

$$\sum_{n=1}^{t^*} C_n < \sum_{n=1}^{t^*} B_n$$

Where,  $t^*$  is the lowest value of 'n' for which inequality holds.

#### 3.3.4.4 Internal Rate of Return (IRR)

99

Internal rate of return equates the discounted benefits with the discounted costs. In other words, it is the discount rate which equates the present worth of benefits to present worth of costs. It represents the average earning capacity of an investment over the economic life period of the project. Mathematically, it is represented as:

$$\sum_{t=1}^n \frac{B_n - C_n}{(1+r^*)^n} = 0$$

Where,

$B_n$  = Benefit in year  $n$

$C_n$  = Cost in year  $n$

$n$  = Number of years

$r^*$  = Internal rate of return

The IRR is arrived at through interpolation technique by using different discount rates so as to see that the net present worth is equated to zero. Therefore, the project costs and benefits are discounted at a certain rate to find out the present worth of the project, so that it is positive. Again by selecting a higher discount rate the costs and benefits are discounted throughout the project period to get a negative net present worth. Then IRR is arrived at through interpolation as follows.

$$IRR = \text{Lower discount rate} + \frac{\text{Difference between the two discount rates}}{\left( \frac{\text{Present worth of cash flows at lower discount rate}}{\text{Absolute difference between the present worth of cash flow streams at two discount rates}} \right)}$$

The IRR should be more than the ruling interest rates for promising economic feasibility and financial soundness.

### 3.3.5 Lorenz Curve Technique

Lorenz Curve technique was used for analysing market power concentration with commission agents for potato transacted in selected markets. Besides graphical representation with Lorenz curve, Lorenz coefficient of inequality was also estimated using the following formula:

$$L = 1 - \frac{\sum_{i=1}^n (X_i - X_{i-j}) (Y_i + Y_{i-j})}{10,000}$$

Where,

L = Lorenz Coefficient of Inequality

$X_i$  = Cumulative percentage of number of firms up to and including  $i^{\text{th}}$  class

$Y_i$  = Cumulative percentage of quantity handled or value of transaction by firms up to and including  $i^{\text{th}}$  class.

$n$  = number of firms / size groups

$i$  takes value 1,2,3 .....  $n$  size groups.

$L$  value ranges between 0 and 1.

When,

$L = 0$ , there is a perfect equality in the distribution.

$L = 1$ , there is a perfect inequality in the distribution.

### 3.3.6 Markov chain analysis

The trade directions of Indian exports were analysed using the first order Markov chain approach (Laxminarayana, 1993). Central to Markov chain analysis is the estimation of the transitional probability matrix  $P$ . The elements  $P_{ij}$  of the matrix  $P$  indicates the probability that export will switch from country  $i$  to country  $j$  with the passage of time. The diagonal elements of the matrix measure the probability that the export share of a country will be retained. Hence, an examination of the diagonal elements indicates the loyalty of an importing country to a particular country's exports. The export data from 1993-2000 were used for the analysis.

In the context of the current application, six major importing countries of potato were considered. The average exports to a particular country was considered to be a random variable which depends only on the past exports to that country, which can be denoted algebraically as

$$E_{jt} = \sum_{i=1}^r E_{it-1} \times P_{ij} + e_{jt}$$



Where,

$E_{jt}$  = Exports from India to  $j^{\text{th}}$  country during the year  $t$ .

$E_{it-1}$  = Exports to  $i^{\text{th}}$  country during the period  $t-1$ .

$P_{ij}$  = Probability that the exports will shift from  $i^{\text{th}}$  country to  $j^{\text{th}}$  country.

$e_{jt}$  = The error term which is statistically independent of  $E_{it-1}$ .

$t$  = Number of years considered for the analysis

$r$  = Number of importing countries

The transitional probabilities  $P_{ij}$  which can be arranged in a  $(c \times r)$  matrix, have the following properties.

$$0 \leq P_{ij} \leq 1$$

$$\sum_{i=1}^n P_{ij} = 1 \text{ for all } i$$

Thus, the expected export shares of each country during period ' $t$ ' were obtained by multiplying the export to these countries in the previous period  $(t-1)$  with the transitional probability matrix.

There are several approaches to estimate the transitional probabilities of the Markov chain model such as unweighted restricted least squares, weighted restricted least squares, Bayesia maximum likelihood, unrestricted least squares, etc. In the present study,

minimum absolute deviations (MAD) estimation procedure was employed to estimate the transitional probabilities which minimize the sum of absolute deviations. The conventional linear programming technique was used, as this satisfies the properties of transitional probabilities of non-negativity restrictions and row sum constraints in estimation.

The linear programming formulation is stated as:

$$\text{Min } OP^* + Ie$$

Subject to

$$XP^* + V = Y$$

$$GP^* = 1$$

$$P^* \geq 0$$

Where,

$O$  is the vector of zeroes.

$P^*$  is the vector in which probability  $P_{ij}$  are arranged.

$I$  is an apparently dimensioned vector of area.

$E$  is a vector of absolute error ( $|UI|$ ).

$Y$  is the vector of export to each country.

$X$  is the block diagonal matrix of lagged values of  $Y$

$V$  is the vector of errors

$G$  is the grouping matrix to add the row elements of  $P$  arranged in  $P^*$  to unity

Using the estimated transitional probabilities, the exports of potato to various destinations were predicted by multiplying the same with the respective shares of base year.

The export shares of Indian potato to different countries were predicted for different time periods by using n-step transitional probabilities. The n-step transitional probabilities are used to predict the export shares for 'n' years from the base year. The 'n' step transitional probabilities indicates the possibility that exports will switch over from one country to another country and probability of retaining exports of a country after 'n' years from now.

### **3.3.6.1 Nominal protection coefficient (NPC)**

Nominal protection coefficients were computed (Ashalatha, 2000) to determine the extent of competitive advantage enjoyed by the commodity in the context of free trade. The coefficients shed light on whether a country has comparative advantage in the export of that commodity in a free trade scenario or not.

The nominal protection coefficient (NPC) is defined as the ratio of the domestic price to the world reference price of the commodity under consideration.

Symbolically,  $NPC = P_d / P_r$

Where,

NPC= Nominal protection coefficient

$P_d$  = Domestic price of the commodity in question

$P_r$  = World reference price of the commodity in question i.e.,  
what the farmer would have received in case of free  
trade.

If the nominal protection coefficient is greater than one, then the commodity is protected, compared to the situation what would prevail under free trade and if it is less than one the commodity is disprotected.

The domestic price is the auction price of potato prevailing in selected markets of the country. The reference price is the international price adjusted for transfer costs, marketing and trading margins including any processing to make the domestic commodity equivalent to the internationally traded commodity.

These co-efficients are estimated under two scenarios viz., import scenario and export scenario.

Under importable scenario, the competition is deemed to take place at the domestic port and therefore international and domestic transportation cost accord a natural protection to the domestic commodity.

Under exportable scenario competition is assumed to take place at foreign port and therefore domestic commodity has to be extra efficient to the tune of international transportation costs at least. These two hypotheses therefore yield different estimates of protection.

In this study the point of competition between domestic production and imports from UK was taken for importable hypothesis

The international reference price in case of importable hypothesis was calculated as given in Table 3.2

Under exportable hypothesis, the pre-assumption is that Indian potato would compete with the international market potato. Therefore, Indian potato price must be low enough to make it competitive in the foreign market. The reference price in case of exportable hypothesis was calculated as given in Table 3.3.

The international prices of potato published by DGCIS Statistics and British Potato council were collected. The freight charges, transportation charges and port clearing charges were collected from the exporters for the years 1999-02.

The interpretations of the co-efficient is as follows.

Under importable hypothesis:

$NPC < 1$  an efficient import substitute

Under exportable hypothesis:

$NPC < 1$  an efficient exportable commodity

**Table 3.2. Nominal protection coefficient of Indian potato (Importable hypothesis)**

| Sl. No. | Particulars                                 | Place     | Unit    |
|---------|---------------------------------------------|-----------|---------|
| 1.      | FOB price                                   | UK        | \$/Qtl  |
| 2.      | Plus freight charge                         |           | \$/Qtl  |
| 3.      | Plus insurance at 1%                        |           | \$/Qtl  |
| 4.      | Equals CIF price                            |           | \$/Qtl  |
| 5.      | Exchange rate                               |           | 1\$= Rs |
| 6.      | Equals landed price                         | Chennai   | Rs/Qtl  |
| 7.      | Plus handling and transport cost to         | Bangalore | Rs/Qtl  |
| 8.      | Equals landed price                         | Bangalore | Rs/Qtl  |
| 9.      | Wholesale price of potato (Reference price) | Bangalore | Rs /Qtl |
| 10.     | NPC of potato (Row 9/Row 8)                 |           |         |

Note: FOB - Free on board

CIF - Cost insurance and freight

**Table 3.3. Nominal protection coefficient of Indian potato (Exportable hypothesis)**

| Sl. No. | Particulars                                  | Place     | Unit    |
|---------|----------------------------------------------|-----------|---------|
| 1.      | Wholesale price of potato                    | Bangalore | Rs/Qtl  |
| 2.      | Plus packing, handling and transport cost to | Chennai   | Rs/Qtl  |
| 3.      | Plus marketing margin (5%)                   |           | Rs/Qtl  |
| 4.      | Equals FOB price                             | Chennai   | Rs/Qtl  |
| 5.      | Plus freight charge                          |           | Rs/Qtl  |
| 6.      | Plus insurance at 1%                         |           | Rs/Qtl  |
| 7.      | Equals landed price                          | UK        | Rs/Qtl  |
| 8.      | Exchange rate                                |           | 1\$= Rs |
| 9.      | Equals landed cost (CIF price)               |           | \$/Qtl  |
| 10.     | Reference price                              | UK        | \$/Qtl  |
| 11.     | NPC of potato (Row 9/Row 10)                 |           |         |

Note: FOB - Free on board

CIF - Cost insurance and freight

### 3.3.6.2 Domestic Resource Cost (DRC)

The DRC is defined as the value of domestic resources, it takes to save or earn a unit of foreign exchange through the production or export of the commodity.

Thus,

$$\text{DRC} = \frac{\sum_{j=k+1}^j A_{ij} P_j^S}{P^R - \sum_{j=1}^k A_{ij} P_j^R}$$

Where,

$A_{ij}$  = Quantity of  $j$ th input required to produce one unit of  $i$ th output.

$P_j^S$  = Shadow price (social price or opportunity cost of  $j$ th non-traded input)

$P^R$  = World reference price of the output.

$P_j^R$  = World reference price of  $j$ th traded input.

$j$  =  $i$  to  $k$  traded inputs.

Non-traded inputs are those factors which are not normally traded internationally.



To estimate DRC of potato, shadow prices of potato were taken as a proxy for social costs. Shadow prices of the input are the product of the marginal product of the input and the domestic price of the output. Thus,

$$\text{Shadow price} = MP_J \times P^D$$

$MP_J$  = Marginal product of the jth input.

$P^D$  = Domestic price of the output.

In this study, the non-traded inputs considered were farm-yard manure and human labour. The data to calculate the DRC of potato (the input cost structure) was obtained from the primary source through pre-tested interview schedule.

Decision Rule is, when the estimated value of

$DRC < 1$ , the input is used efficiently and is export competitive;

$DRC > 1$ , the input is used inefficiently and is not export competitive.

NPC refers to the protection accorded to the commodity (in this case potato) including all the inputs and DRC indicates whether it is profitable to produce and export the commodity (potato).

### 3.3.7 Linear programming model

Linear programming technique was used for formulation of transportation model for the current study. The transportation method of

programming was developed originally to schedule the optimum allocation of cargo vessel where the optimum allocation minimizes the distance travelled by Ships when certain fixed transportation requirements are being met. The method is applicable also to problems of road, air and to some extent rail transportation. The method may be used to determine the least cost resource of materials to a marketing or processing firm. It may be used for a firm with producing plants at different locations and consuming or sales centres at other locations. The method also may be normatively used to show how the output of numerous producers at many locations should flow to many consuming centres if competitive conditions are to be attained and cost to be minimized.

### **Mathematical formulation of the model**

In linear programming analysis, a linear function of a number of variables is to be maximized (or minimized) subject to a number of constraints in the form of linear equalities and inequalities. The linear programming model employed in this study is given below:

#### **A) Cost minimisation model**

$$\text{Minimize } Z = \sum_{i=1}^m \sum_{j=1}^n C_{ij} X_{ij}$$

Subject to the constraints,

$$1. \sum_{i=1}^n X_{ij} < S_i \quad (i = 1, \dots, m)$$

$$2. \sum_{i=1}^m X_{ij} < D_i \quad (i = 1, \dots, n)$$

$$3. \sum X_{ij} \geq 0 \text{ for all } i \text{ and } j$$

Where,

$Z$  is the objective function to be maximized

$C_{ij}$  = cost of transportation per unit of commodity from  $i^{\text{th}}$  source to  $j^{\text{th}}$  destination.

$X_{ij}$  = number of units transported from  $i^{\text{th}}$  place to  $j^{\text{th}}$  place.

$S$  = Total supply

$D$  = Total demand

$m$  = number of sources ( $m = 5$ )

$n$  = number of destinations ( $n = 5$ )

## B) Profit maximisation model

$$\text{Maximize } Z = \sum_{i=1}^m \sum_{j=1}^n X_{ij} \Pi_{ij}$$

Subject to the constraints,

$$1. \sum_{i=1}^n X_{ij} < S_i \quad (i = 1, \dots, m)$$

$$2. \sum_{i=1}^m X_{ij} < D_i \quad (i = 1, \dots, n)$$

$$3. \sum X_{ij} \geq 0 \quad \text{for all } i \text{ and } j$$

Where,

Z is the objective function to be maximized

$\Pi_{ij}$  = profit earned by transportation of a unit of commodity from  $i^{\text{th}}$  source to  $j^{\text{th}}$  destination.

$X_{ij}$  = number of units transported from  $i^{\text{th}}$  place to  $j^{\text{th}}$  place.

S = Total supply

D = Total demand

m = number of sources (m= 5)

n = number of destinations (n=5)

### **Objective functions**

The objective function for the model in this study is (1) to minimise the transportation cost to the farming community and (2) to maximize the net profit from the transportation of potato by farming community to different potato markets, subject to the resource constraints as specified in

the model. The objective function value in minimum transportation cost model was obtained by using the minimum transportation cost per quintal. The net profit was measured by deducting the average market price per quintal prevailing in the markets from the average cost of cultivation per quintal and transportation cost per quintal. The value of the objective function (Z) is the total net profit earned by the farming community from transportation of potato to different markets.

### **Basic assumptions**

Besides the general assumption of linearity, divisibility, additivity and finiteness, the following assumption were made while developing the model.

### **Formal Assumptions**

- 1) Each region meets its demand for potato from its own production.
- 2) The supplies of resources or products available at the various origins and the demands of the various destinations are known; and total demand is equal to total supply.
- 3) The cost of moving the commodity from origin to destinations is known and is independent of the number of units moved.
- 4) There is an objective to be maximized or minimized.
- 5) Transportation from origins to destinations can be carried on only at non-negative levels.

- 6) Surplus production is assumed to be exported to neighbouring states.

### **Constraints in the models**

In both the models, the row vectors in the matrix refer to the constraints. The two types of constraints are the supply and demand constraints. The total supply available is less than or equal to the total production while the demand of each region is equal to or less than the total demand of each region.

#### **3.3.8 Simple tabular analysis**

Simple conventional method of tabular analysis was used to assess the constraints and potentials in the production of potato and to ascertain the gaps in the level of infrastructure facilities like storage, processing, transportation and marketing finance in the selected regions.

The storage pattern, preferences of potato farmers and the economics of storing in cold and local storage structures were worked out using simple tabular analysis.

*Results*

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## IV. RESULTS

This chapter presents the results in line with the objectives of the study under the following headings.

- 4.1 Trends in arrivals and prices of potato in major markets of Karnataka.
- 4.2 Seasonal pattern of market arrivals and prices of potato.
- 4.3 Extent of market integration among major markets for potato.
- 4.4 Constraints, potentials and feasibility in the production of uniform grades and quality of potato.
- 4.5 Gaps in the level of infrastructural facilities like storage, processing, transportation and marketing finance in potato.
- 4.6 Constraints in the full exploitation of the capacities of the existing infrastructural facilities and feasibilities of absorption of increased production of potato.
- 4.7 Market structure for potato and development of appropriate model of market structure for efficient marketing.
- 4.8 Identification of the potentials for export of potato both in raw and processed form.



- 4.9 Appropriate logistics model for efficient marketing of potato.
- 4.10 Appropriate policy measures for management of production and prices of potato in Karnataka.

#### **4.1 Trends in arrivals and prices of potato in selected markets of Karnataka**

The exponential method was used to estimate the trends in arrivals and prices of potato in selected markets. The trends help to understand the rate at which the market is growing or decreasing.

##### **4.1.1 Trends in arrivals of potato**

The results obtained using the exponential regression functions are presented in Table 4.1. The table revealed the long term movement of arrivals of potato in the selected markets. All the markets showed positive and significant growth (at one per cent) in arrivals except Hubli market.

Kolar market with a growth rate of 18.2508 per cent per annum had the highest growth during the period under study. Bangalore market followed with a growth rate of 13.0810 per cent per annum. The least growth was noticed in Hubli market (0.9146 per cent). However it was non significant.

##### **4.1.2 Trends in prices of potato**

From Table 4.2, it may be seen that Hassan market had the highest annual increase in prices with a growth rate of 6.896 per cent. Hubli

**Table 4.1. Trends in Arrivals of Potato**

| Markets        | Trend equation<br>$\ln Y = \ln A + B \ln X$ | R <sup>2</sup> values | t values  | CGR( % ) | F values   |
|----------------|---------------------------------------------|-----------------------|-----------|----------|------------|
| Bangalore      | $Y=13.6267 + 0.1229 X$                      | 0.6593                | 3.9345*** | 13.0810  | 15.4806*** |
| Belgaum        | $Y=12.5796 + 0.06519 X$                     | 0.4161                | 2.6696**  | 6.7361   | 7.1267***  |
| Chikkaballapur | $Y=9.6357 + 0.0685 X$                       | 0.5903                | 3.7962*** | 7.0880   | 14.4109*** |
| Hassan         | $Y=11.2808 + 0.1011 X$                      | 0.5094                | 3.2221*** | 10.6372  | 10.3823*** |
| Hubli          | $Y=12.3462 + 0.0091 X$                      | 0.0467                | 0.6671 NS | 0.9146   | 0.4418 NS  |
| Kolar          | $Y= 9.7659 + 0.1676 X$                      | 0.7824                | 5.9963*** | 18.2508  | 35.9550*** |

\*\*\* - significant at 1 per cent level

\*\* - significant at 5 per cent level

\* - significant at 10 per cent level

NS - Non significant

**Table 4.2. Trends in prices of Potato**

| Markets        | Trend equation<br>$\ln Y = \ln A + B \ln X$ | R <sup>2</sup> values | t values              | CGR( % ) | F values               |
|----------------|---------------------------------------------|-----------------------|-----------------------|----------|------------------------|
| Bangalore      | $Y=5.6610 + 0.0454 X$                       | 0.2341                | 1.5636 <sup>NS</sup>  | 4.6455   | 2.4449 <sup>NS</sup>   |
| Belgaum        | $Y=5.5541 + 0.0585 X$                       | 0.4140                | 2.6578 <sup>**</sup>  | 6.0242   | 7.0642 <sup>***</sup>  |
| Chikkaballapur | $Y=5.3195 + 0.0624 X$                       | 0.4467                | 2.8412 <sup>***</sup> | 6.4383   | 8.0725 <sup>***</sup>  |
| Hassan         | $Y=5.3106 + 0.0667 X$                       | 0.8071                | 6.4677 <sup>***</sup> | 6.8960   | 41.8321 <sup>***</sup> |
| Hubli          | $Y=5.4775 + 0.0649 X$                       | 0.4587                | 2.7615 <sup>**</sup>  | 6.7013   | 7.6260 <sup>***</sup>  |
| Kolar          | $Y=5.3104 + 0.0624 X$                       | 0.4467                | 2.8412 <sup>***</sup> | 6.4383   | 16.7908 <sup>***</sup> |

\*\*\* - significant at 1 per cent level

\*\* - significant at 5 per cent level

\* - significant at 10 per cent level

NS - Non significant

**Table 4.3. Trends in area, production and productivity of potato in Karnataka**

| Particulars               | Trend equation<br>$\ln Y = \ln A + B \ln X$ | R <sup>2</sup><br>values | t values   | CGR<br>( % ) | (1990-1999) |  |
|---------------------------|---------------------------------------------|--------------------------|------------|--------------|-------------|--|
|                           |                                             |                          |            |              | F values    |  |
| Area (Ha)                 | $Y = 9.9371 + 0.0542 X$                     | 0.6484                   | 3.5929 *** | 5.5750       | 12.9093***  |  |
| Production<br>(Tonnes)    | $Y = 12.6309 + 0.0303 X$                    | 0.4869                   | 2.5775 **  | 3.0793       | 6.6437**    |  |
| Productivity<br>(Qtl/ Ha) | $Y = 4.9965 - 0.0239 X$                     | 0.1785                   | -1.2333 NS | -2.3656      | -2.3656 NS  |  |

\*\*\* - significant at 1 per cent level

\*\* - significant at 5 per cent level

\* - significant at 10 per cent level

NS - Non significant

followed with 6.7013 per cent while the least was in Bangalore market with an annual growth rate of 4.6455 per cent. All the markets showed a positive and significant growth in prices, except Bangalore where growth rate was non significant

#### **4.1.3 Trends in area, production and productivity of potato in Karnataka**

The trends in area, production and productivity of potato in Karnataka are presented in Table 4.3. The area under potato in Karnataka represented an increasing trend with a growth rate of 5.5750 per cent every year while the production increased at a rate of 3.0793 per cent annually. However, the productivity witnessed a decreasing trend falling at the rate of 2.3656 per cent every year but was non significant.

### **4.2 Pattern of arrivals and prices of potato**

The seasonal pattern of arrivals and prices of potato are presented in figures 4.1 to 4.6.

#### **4.2.1 Seasonal pattern in arrivals of potato**

The seasonal indices of market arrivals of potato in the selected markets are presented in Table 4.4. Monthly seasonal indices were calculated in order to ascertain the long run seasonal variations in arrivals and prices of potato. The results revealed that the seasonality in arrivals existed in all the markets. Arrivals reached peak during November (181.650) in Bangalore, which decreased to (141.427) in

**Table 4.4. Seasonal Indices in arrivals of Potato**

| Months    | Bangalore | Belgaum | Chikkaballapur | Hassan  | Hubli   | Kolar   |
|-----------|-----------|---------|----------------|---------|---------|---------|
| January   | 77.640    | 233.811 | 84.983         | 18.538  | 213.96  | 88.430  |
| February  | 60.987    | 105.416 | 243.429        | 22.340  | 141.930 | 208.570 |
| March     | 84.921    | 52.430  | 256.902        | 18.048  | 84.830  | 371.102 |
| April     | 85.720    | 44.689  | 199.413        | 24.201  | 77.800  | 166.533 |
| May       | 116.345   | 67.713  | 116.568        | 24.455  | 90.320  | 135.025 |
| June      | 91.246    | 100.067 | 84.544         | 39.627  | 51.330  | 50.399  |
| July      | 95.026    | 66.491  | 36.356         | 394.495 | 66.570  | 33.145  |
| August    | 79.011    | 66.480  | 27.686         | 467.199 | 71.210  | 21.261  |
| September | 78.407    | 42.888  | 32.108         | 64.366  | 62.500  | 35.637  |
| October   | 107.619   | 42.037  | 32.178         | 41.324  | 83.92   | 22.078  |
| November  | 181.650   | 70.448  | 35.858         | 55.522  | 105.84  | 24.768  |
| December  | 141.427   | 307.531 | 49.976         | 29.883  | 149.780 | 43.052  |

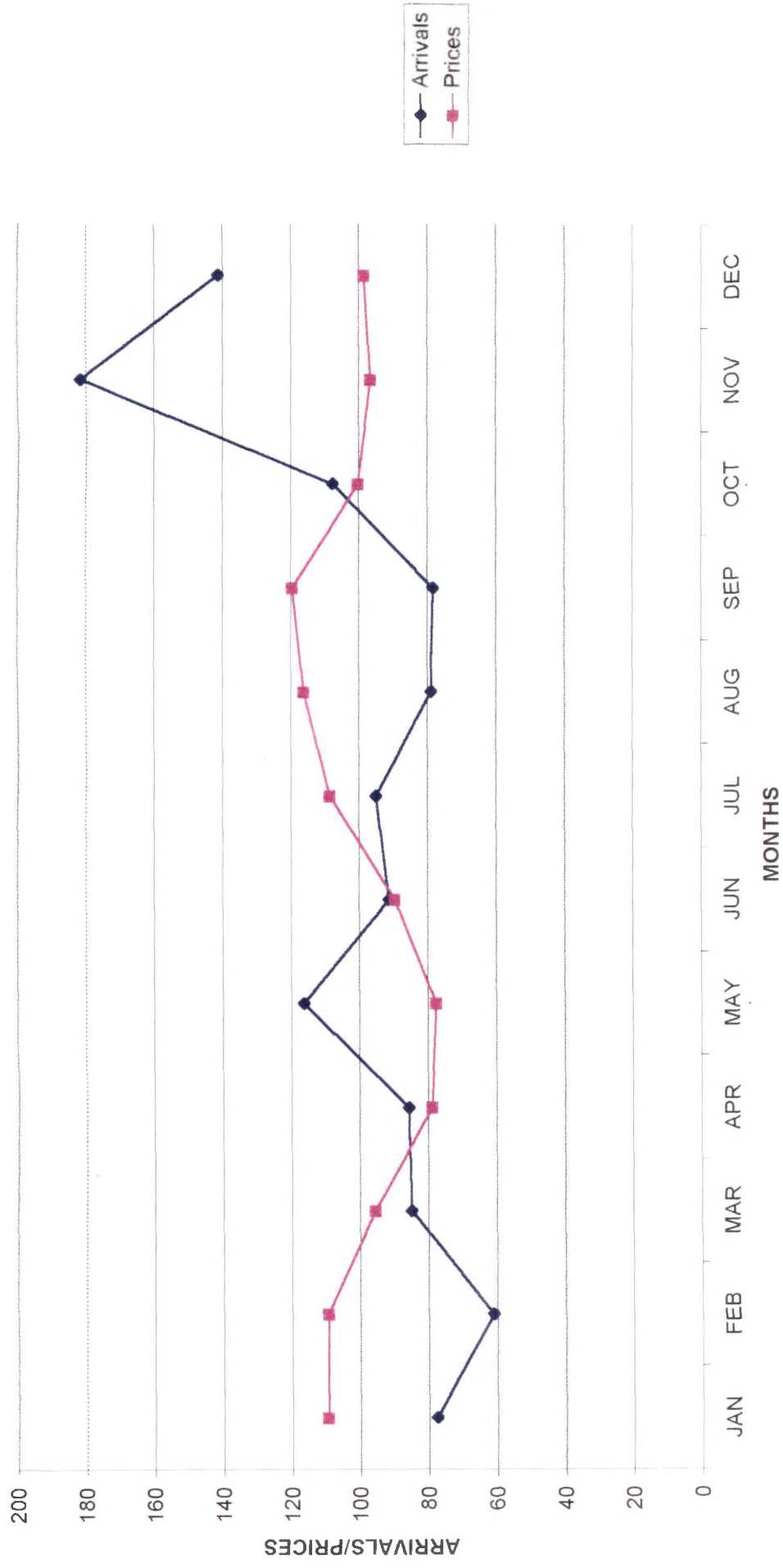


Fig 4.1 Seasonal indices of arrivals and prices of potato in Bangalore market

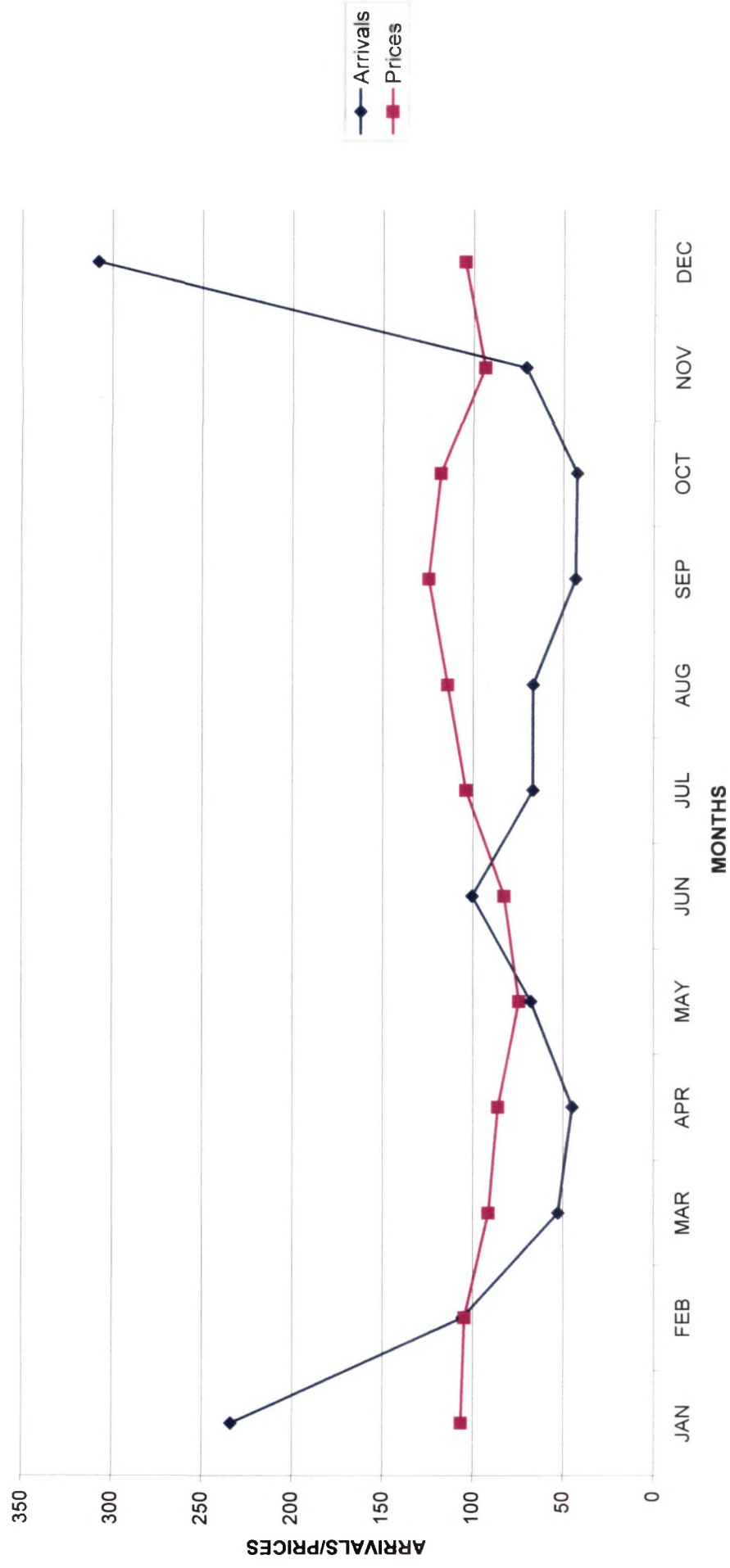


Fig 4.2 Seasonal indices of arrivals and prices of potato in Belgium market



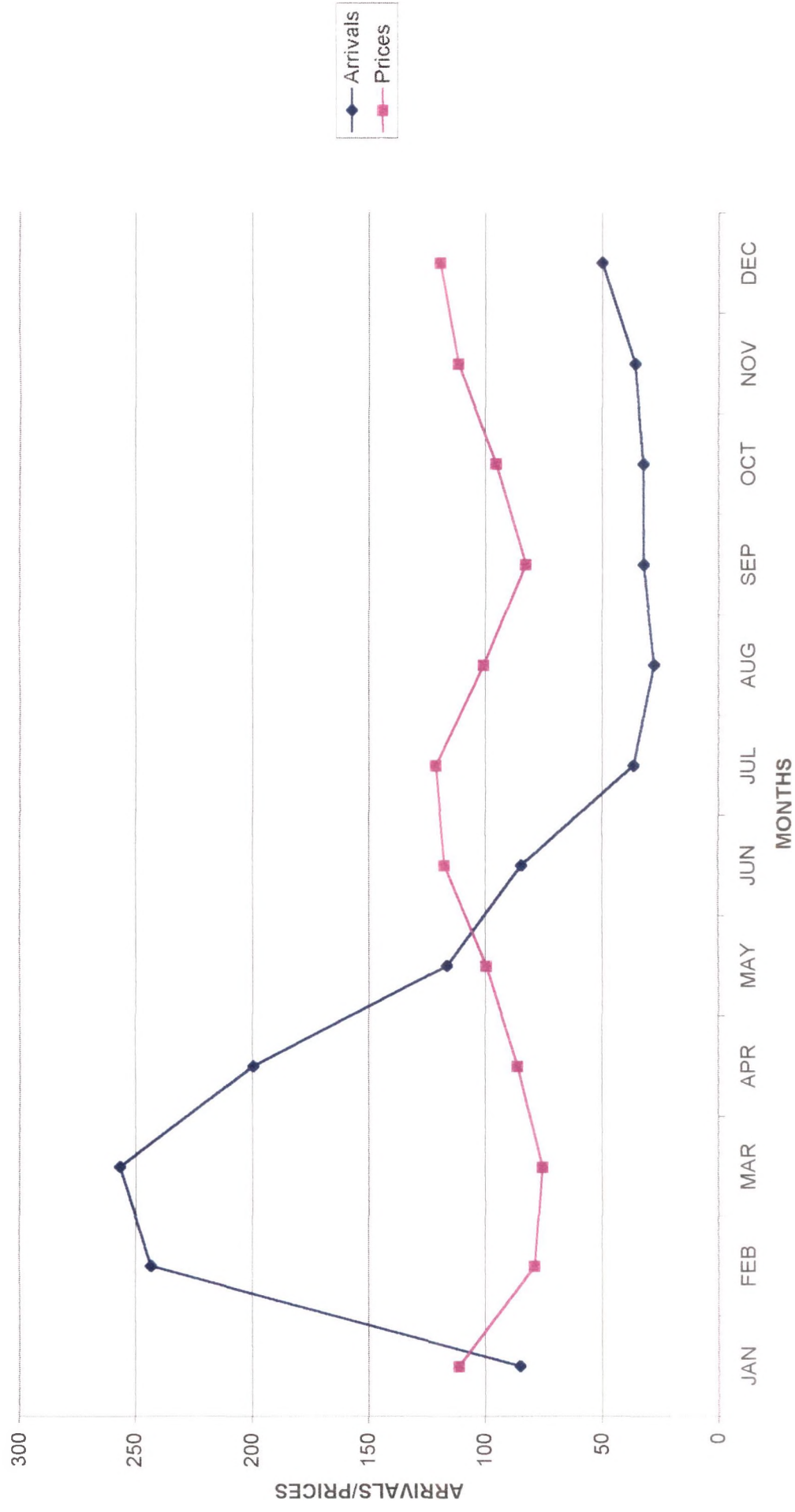


Fig 4.3 Seasonal indices of arrivals and prices of potato in Chikkaballapur market



Fig 4.4 Seasonal indices of arrivals and prices of potato in Hassan market

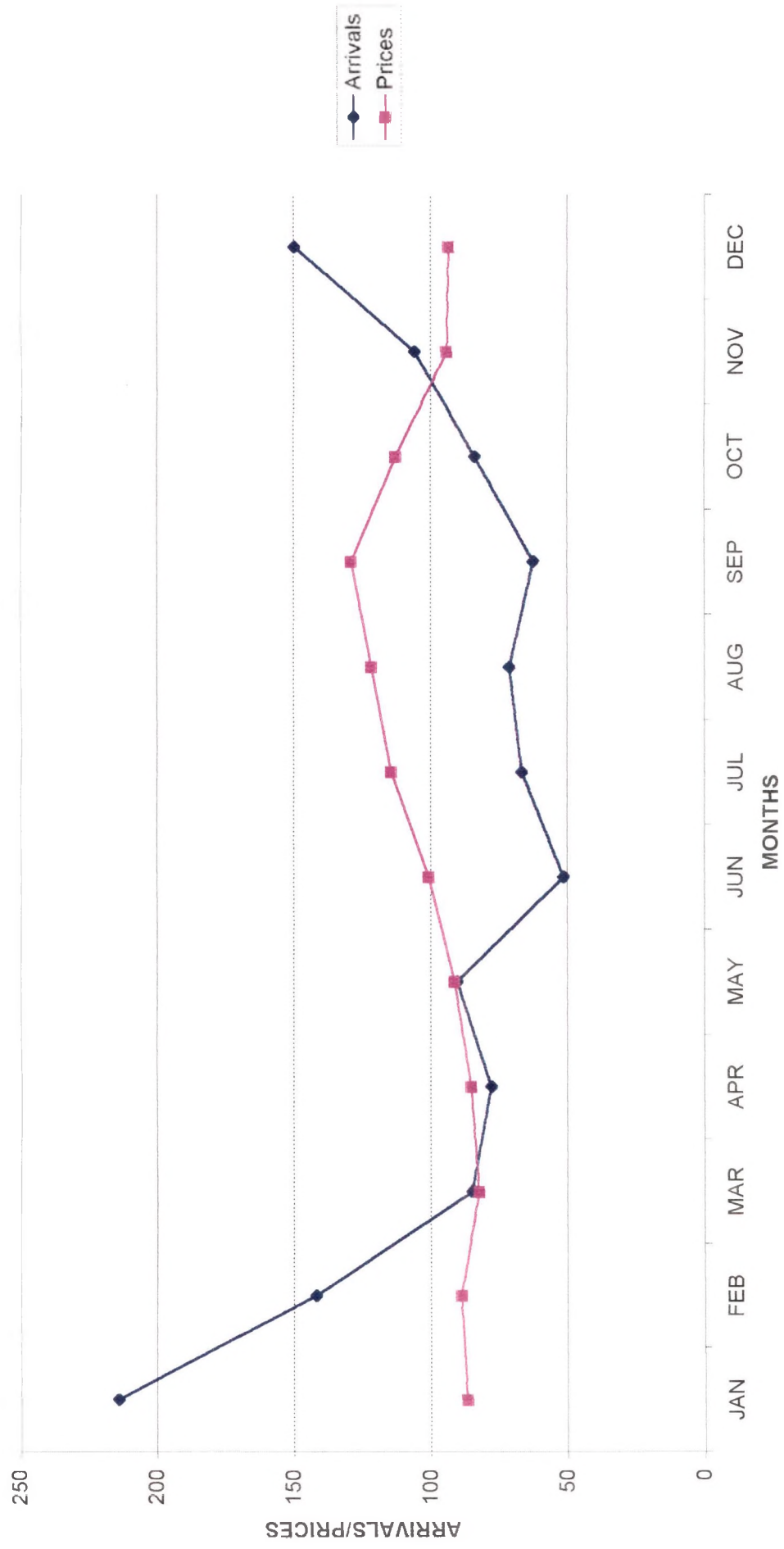


Fig 4.5 Seasonal indices of arrivals and prices of potato in Hubli market

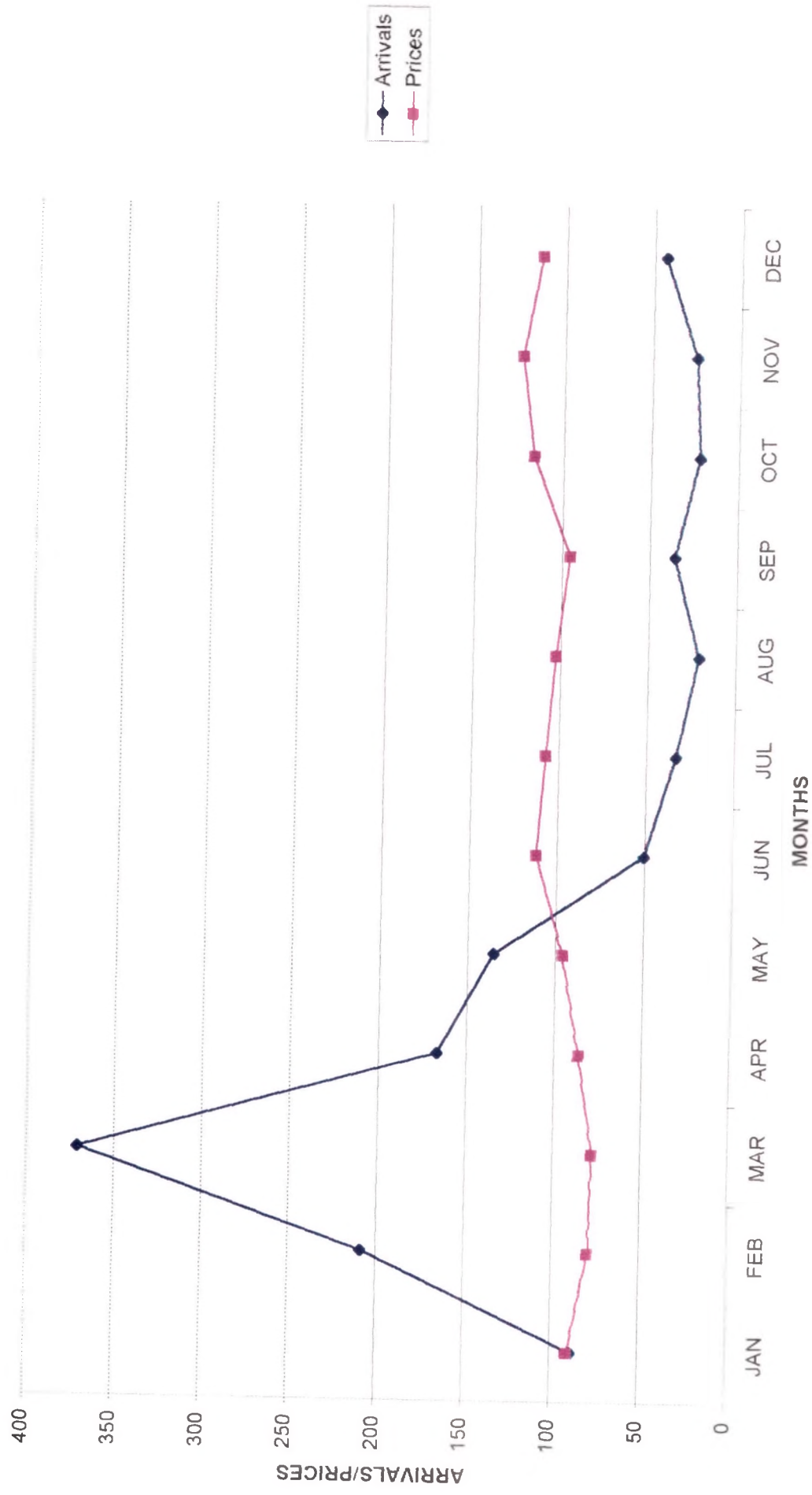


Fig 4.6 Seasonal indices of arrivals and prices of potato in Kolar market

December and relatively shot up in May (116.345). In Belgaum market the peak arrival was found in December (307.531) followed by June (100.067). Chikkaballapur market showed lowest arrivals in September (32.108) while it peaked during March (256.902). Hassan market witnessed the lowest arrivals in March (18.048) and highest during August (467.199). Arrivals reached a peak during March (371.102) in Kolar while they were the lowest in August (21.261). Hubli market witnessed maximum (213.960) arrivals during January while it was the lowest in June (51.33). However no successive peaks were observed in the selected markets except in Bangalore and Belgaum. The arrivals were found to be prominent in the months of May, October, November and December in Bangalore market. Belgaum market noticed relatively higher arrivals during January, February, June and December. Chikkaballapur market witnessed rush in arrivals during February to May months. Hassan market did not witness much variation in arrivals except for peak months of July and August. Hubli market witnessed relatively higher arrivals during the months of November, December, January and February. Higher arrivals were observed during the months January to May in Kolar market.

#### **4.2.2 Seasonal pattern in prices of potato**

The seasonal indices of prices for potato are presented in Table 4.5. The pattern of market prices showed relatively wide differences among the selected markets. The price index in Bangalore market was the highest in the month of September (119.453) and relatively higher during

**Table 4.5. Seasonal indices in prices of potato**

| Months    | Bangalore | Belgaum | Chikkaballapur | Hassan  | Hubli   | Kolar   |
|-----------|-----------|---------|----------------|---------|---------|---------|
| January   | 109.561   | 106.204 | 111.243        | 99.071  | 86.625  | 90.136  |
| February  | 109.309   | 104.218 | 78.889         | 107.338 | 88.728  | 79.324  |
| March     | 95.553    | 90.913  | 75.495         | 99.929  | 82.386  | 77.546  |
| April     | 78.887    | 85.707  | 86.041         | 86.578  | 85.201  | 86.113  |
| May       | 77.543    | 74.101  | 99.698         | 91.226  | 91.316  | 95.935  |
| June      | 89.553    | 82.226  | 117.654        | 104.333 | 100.76  | 111.849 |
| July      | 108.517   | 103.596 | 121.26         | 117.65  | 114.354 | 107.414 |
| August    | 116.246   | 113.771 | 100.813        | 121.483 | 121.608 | 102.474 |
| September | 119.453   | 124.25  | 82.631         | 122.603 | 128.901 | 95.415  |
| October   | 100.261   | 117.478 | 95.409         | 88.304  | 112.647 | 116.722 |
| November  | 96.557    | 93.223  | 111.55         | 74.387  | 94.149  | 123.869 |
| December  | 98.560    | 104.312 | 119.317        | 86.598  | 93.324  | 113.205 |

the months of January (109.561), February (109.301), July (108.517) and August (116.246). The prices during March to June represented comparatively stable as revealed by the indices. Belgaum market witnessed peak prices during September (124.250) and relatively higher prices during all the months except during May (74.101). The indices in other months varied from 82.226 to 117.478 in Belgaum market.

A peak of 121.26 in index was observed during July in Chikkaballapur market followed by December (119.317) and June (117.654). However the prices tend to be stable during the rest of the year. Hassan market showed market situation very similar to that in Bangalore market where higher indices were found during the months of June to September. Other months showed relatively stable market prices with the index varying from 74.387 in November to 99.929 in March.

The market prices of potato were found to be the highest from July to October with subsequent fall in prices during (November to March) in Hubli market. Kolar market witnessed higher prices during October, November and December. The second peak was observed from June to August, while the remaining months witnessed very stable prices. In sum, in majority of the markets, prices of potato peaked during September.

### **4.2.3 Cyclical variations in arrivals and prices of potato in Karnataka**

The cyclical variations in arrivals and prices of potato are presented in figures 4.7 to 4.14. It could be seen from the figures that there was no cycle in any of the selected markets.

### **4.3 Market integration**

The market integration concept explains the relationship between the prices in the two markets that are spatially separated. When markets are integrated it implies that the markets in the system operate in unison, as a single market system. The existence of integration in the markets influences the conduct of the firms in the market and consequently the marketing efficiency. The behaviour of a highly integrated market is different from that of a lesser integrated or disintegrated market. Markets located in different areas differ in the extent of integration and therefore, variation exists in their degree of efficiency. As a result of this, prices of the commodity tend to vary in different markets.

Price in one market does vary with the actions of buyers and sellers in other markets. The degree to which price formation in one market is related to the process of price formation in other markets can be shown through a zero order correlation matrix of prices in these markets. The same technique was made use of in this study and the results of the analysis are presented in Table 4.6.



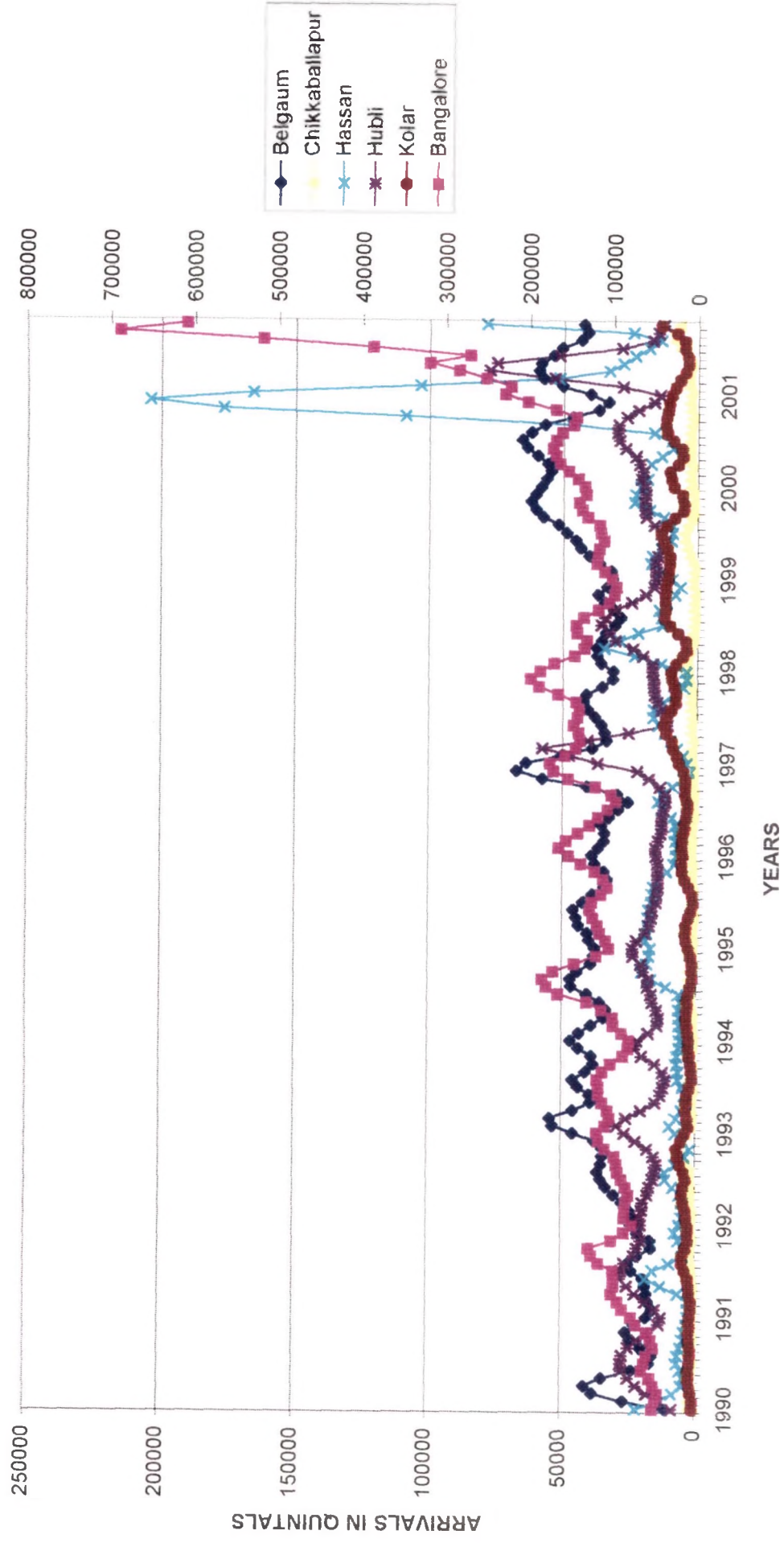


Fig 4.7 Cyclical variations in market arrivals of potato in Karnataka

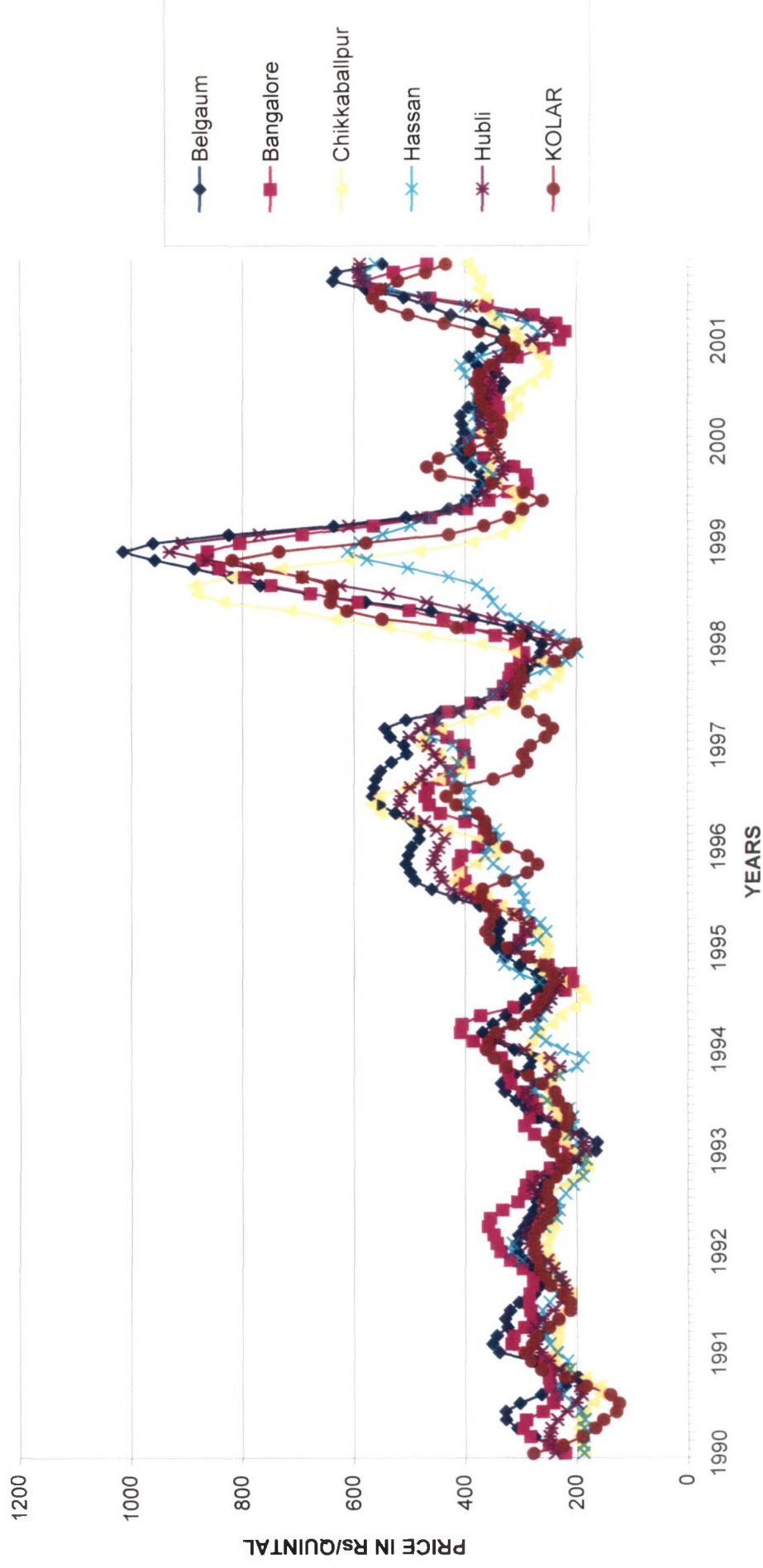


**Fig 4.8 Cyclical variations in market prices of potato in Karnataka**

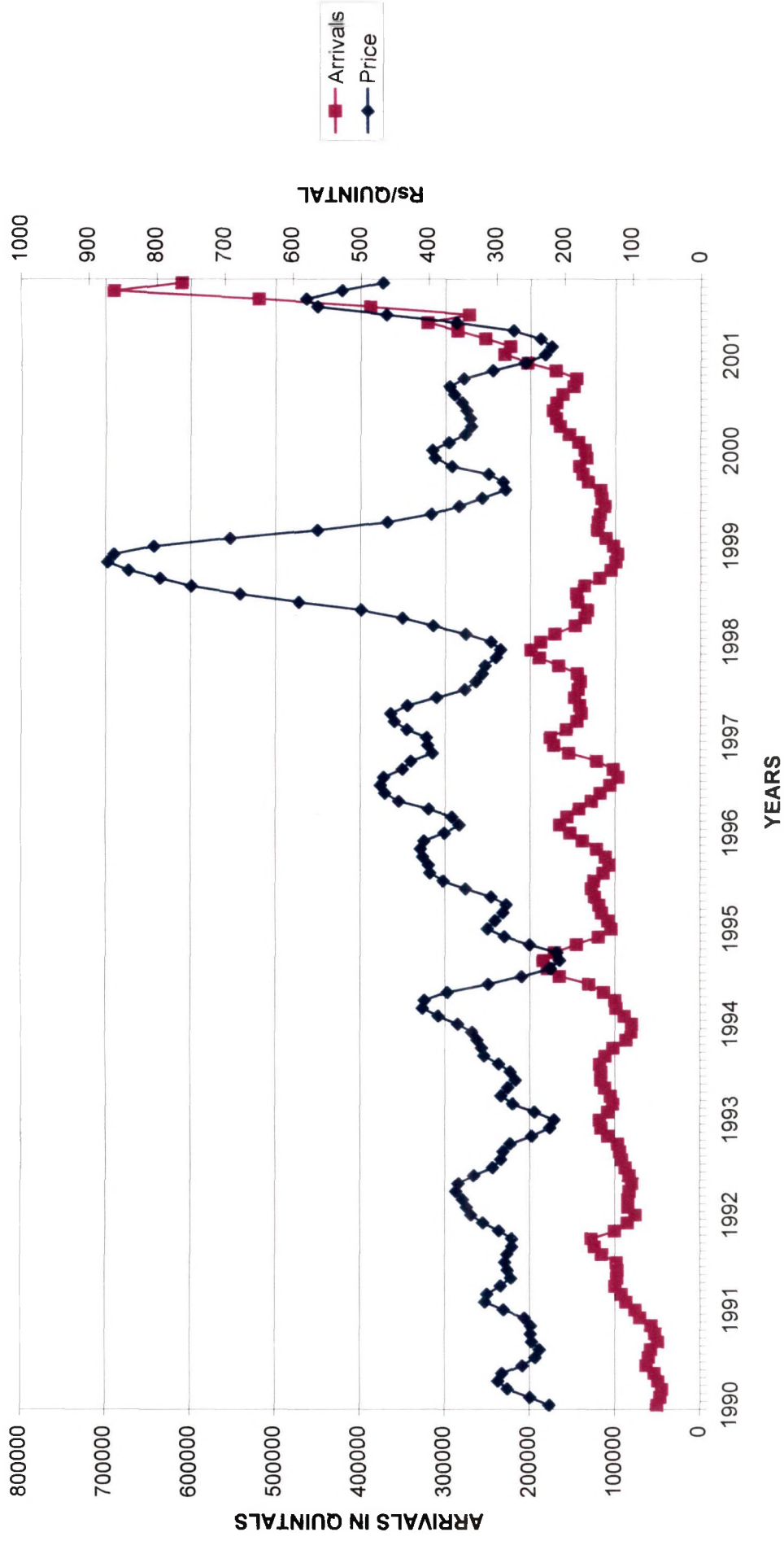


Fig 4.9 Cyclical variations in arrivals and prices in Bangalore market

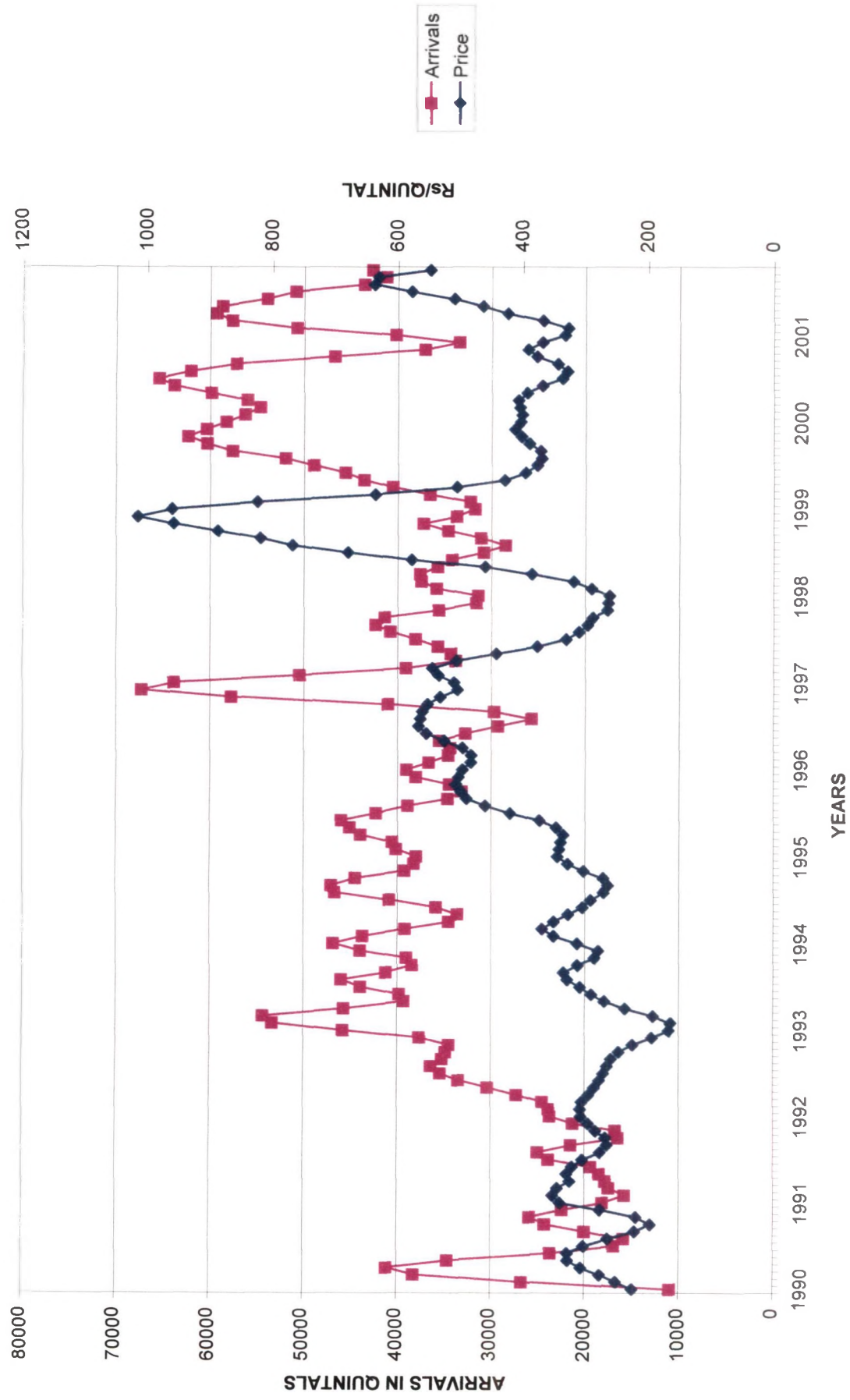


Fig 4.10 Cyclical variations in arrivals and prices in Belgaum market

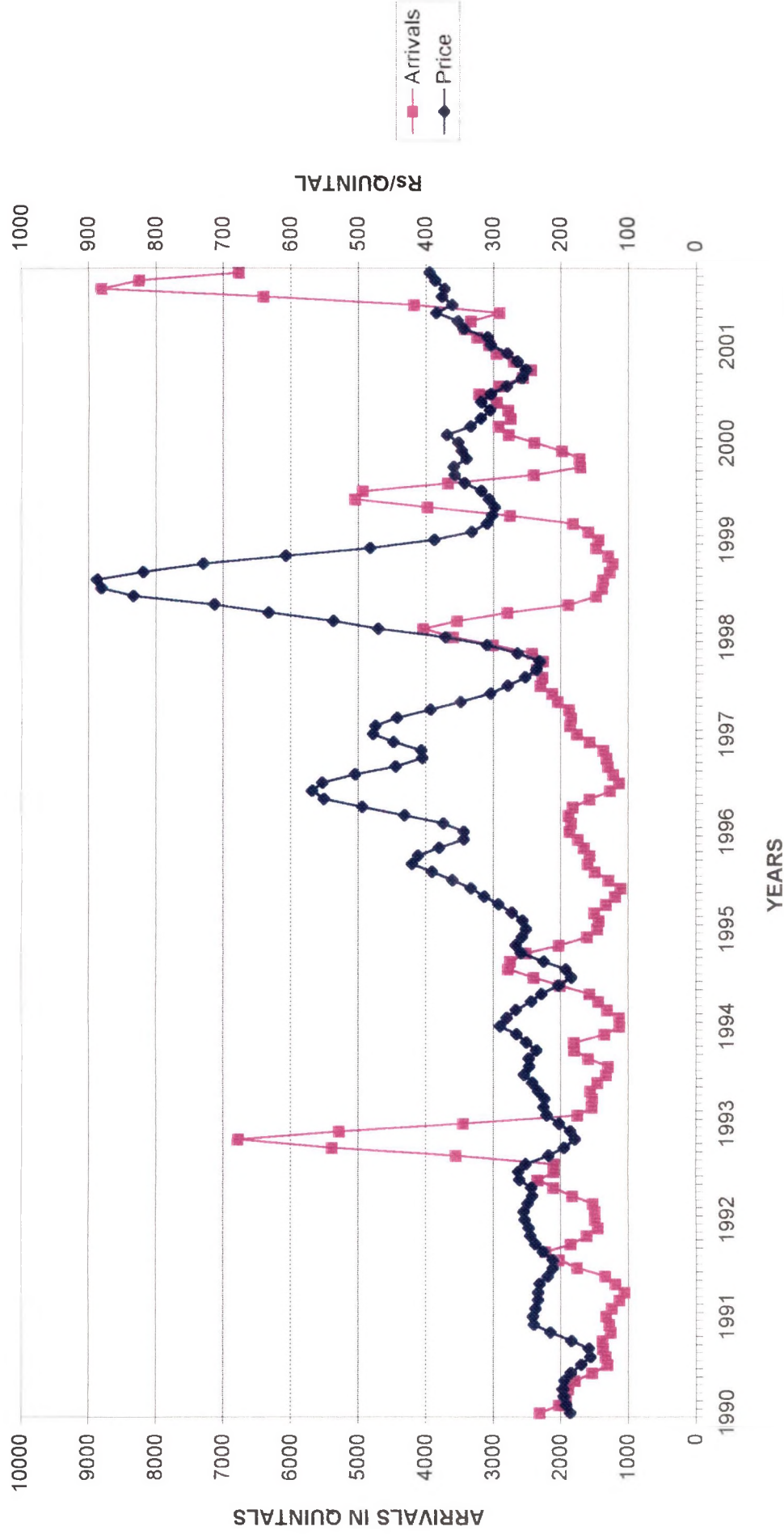


Fig 4.11 Cyclical variations in arrivals and prices in Chikkaballapur market



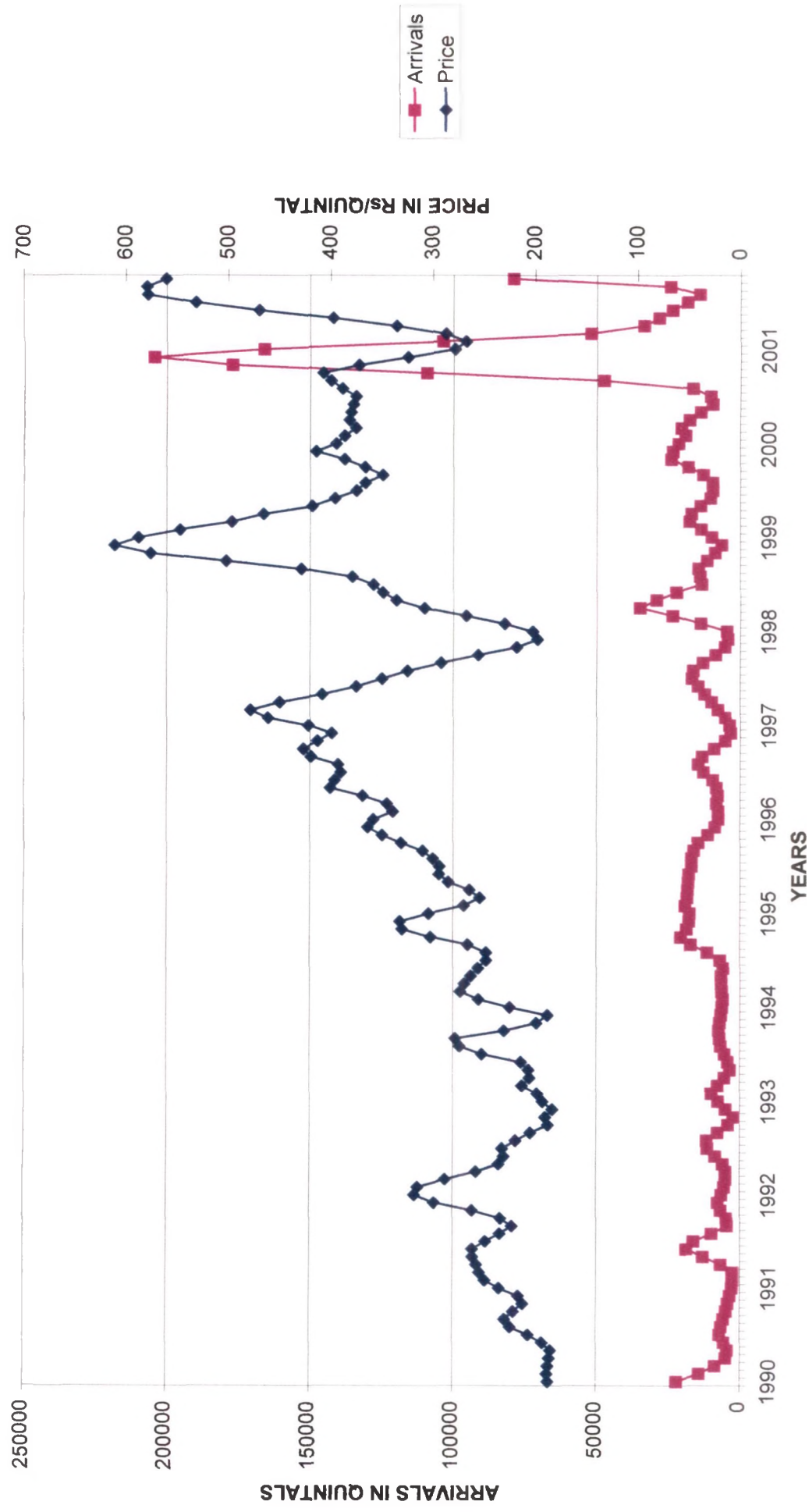


Fig 4.12 Cyclical variations in arrivals and prices in Hassan market

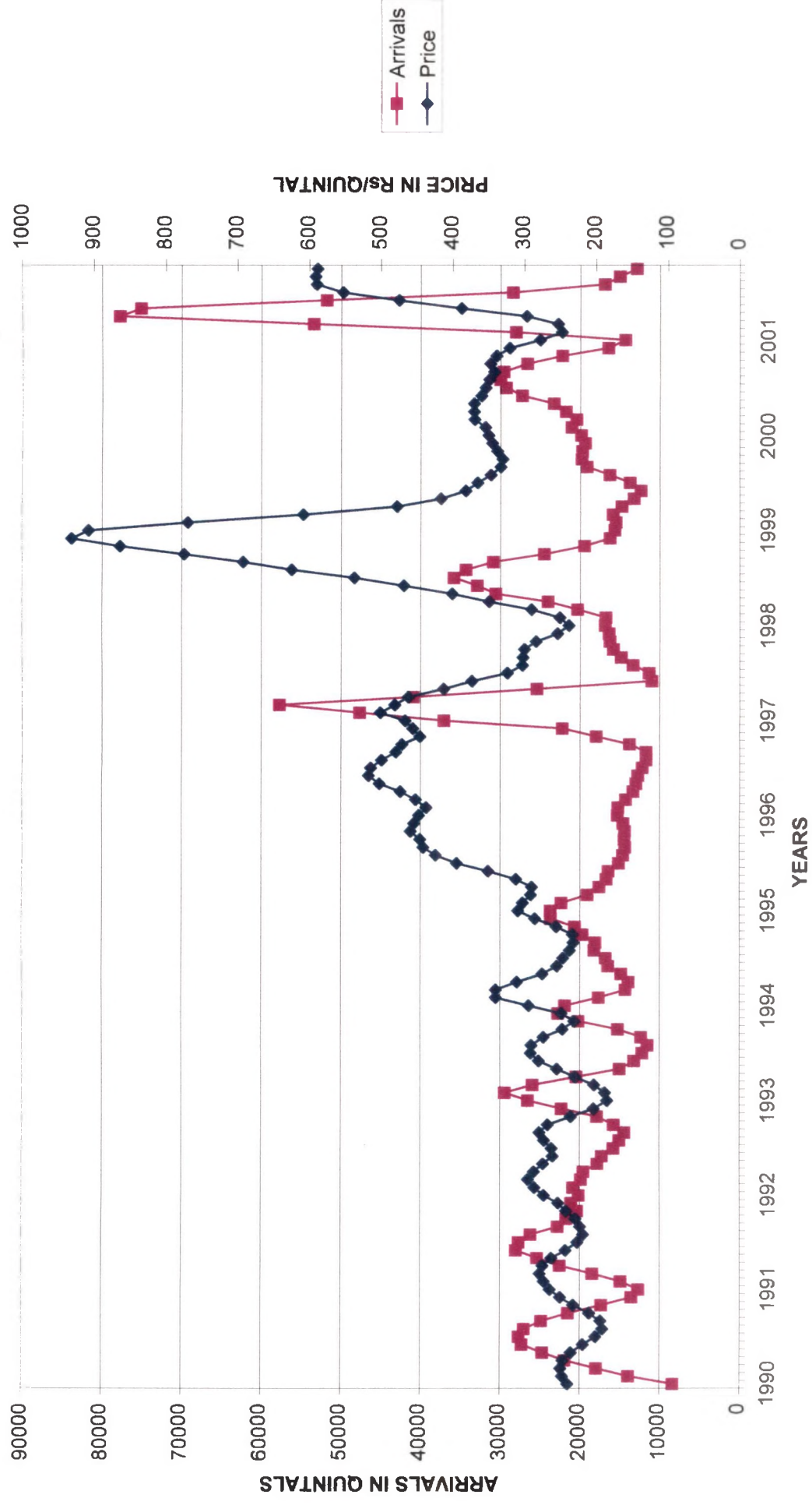


Fig 4.13 Cyclical variations in arrivals and prices in Hubli market

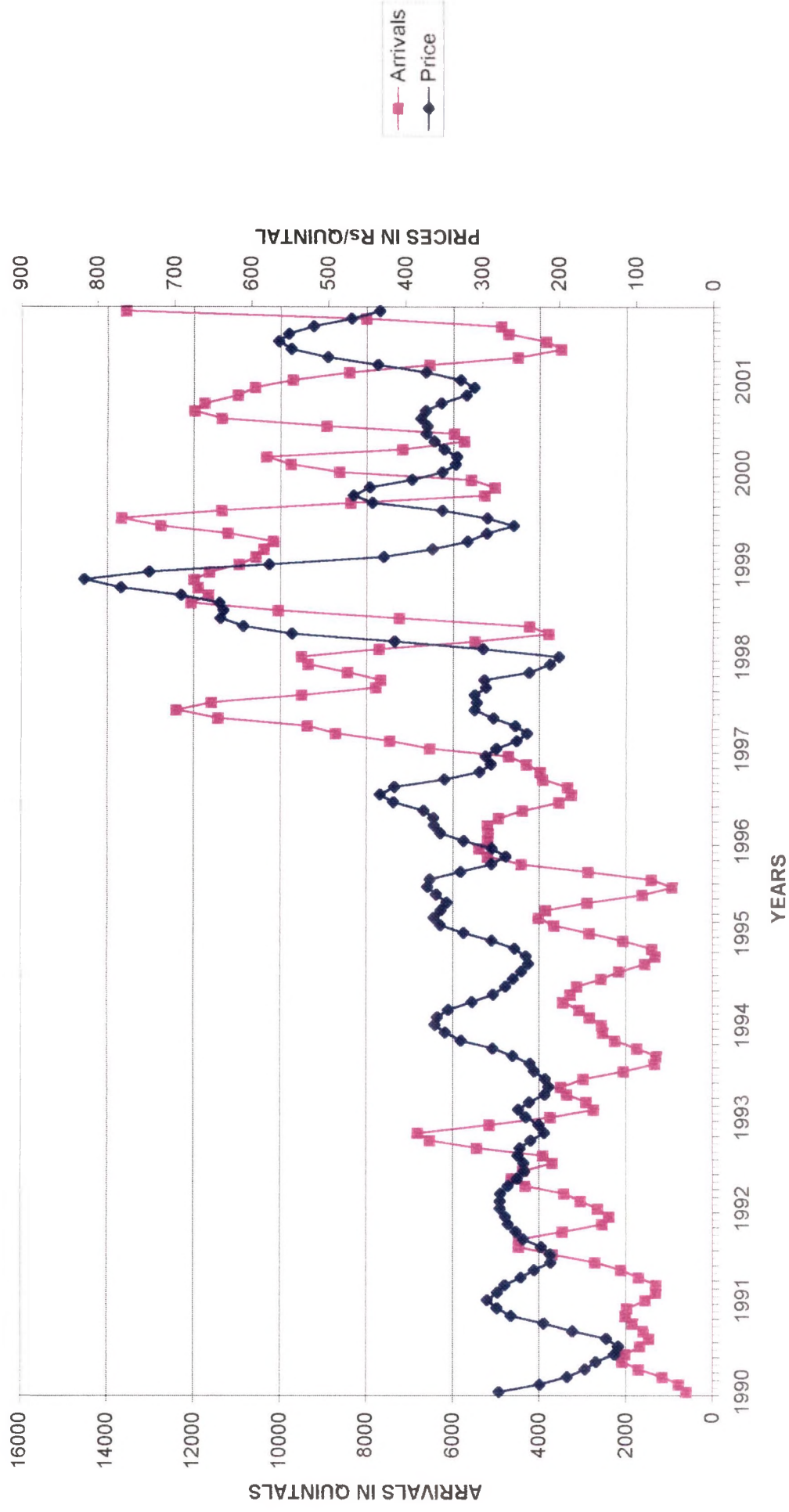


Fig 4.14 Cyclical variations in arrivals and prices in Kolar market



**Table 4.6. Correlation coefficients of prices of potato in selected markets of Karnataka (1990-2001)**

| Districts      | Bangalore market | Belgaum market | Chikkaballapur market | Hassan market | Hubli Market | Kolar market |
|----------------|------------------|----------------|-----------------------|---------------|--------------|--------------|
| Bangalore      | 1.000            | 0.861***       | 0.824***              | 0.673***      | 0.856***     | 0.783***     |
| Belgaum        |                  | 1.000          | 0.875***              | 0.725***      | 0.904***     | 0.792***     |
| Chikkaballapur |                  |                | 1.000                 | 0.671***      | 0.796***     | 0.716***     |
| Hassan         |                  |                |                       | 1.000         | 0.759***     | 0.597***     |
| Hubli          |                  |                |                       |               | 1.000        | 0.736***     |
| Kolar          |                  |                |                       |               |              | 1.000        |

\*\*\* Correlation is significant at one per cent

Table 4.6 shows that there was a strong integration between the selected markets. The lowest correlation coefficient (0.597) was between Hassan and Kolar while the highest correlation coefficient (0.904) was exhibited between Hubli and Belgaum markets.

Bangalore had the highest integration (0.861) with Belgaum market and the least with Hassan (0.673). Belgaum market was highly integrated (0.904) with Hubli market and the least with Hassan (0.725). Chikkaballapur was more integrated with Hubli (0.796) than with Hassan (0.671) and Kolar (0.716) markets. Hassan market was more integrated with Hubli market (0.759) prices than with Kolar market prices (0.597).

From the table, it could be further concluded that all the markets under study are highly integrated with reference to price and all the correlation coefficients were significant at one per cent level of significance.

#### **4.4 Constraints, potentials and feasibility in the production of uniform quality of potato**

A primary survey consisting of 100 farmers was undertaken in the selected districts to elucidate the opinion of farmers regarding the constraints faced by them in production of uniform grades of potato and the results are presented in Table 4.7.

Potato seeds were timely available and in adequate quantities in all the selected districts. Majority of the farmers opined that the potato seeds

**Table 4.7. Constraints in production of uniform grades/ quality of potato**

(in percentages)

| Districts | Availability of seeds |            |          |            | Quality of seeds |             | Selection of seeds |          | Constraints in adoption of package of practices |                         |      |
|-----------|-----------------------|------------|----------|------------|------------------|-------------|--------------------|----------|-------------------------------------------------|-------------------------|------|
|           | Timely                | Non Timely | Adequate | Inadequate | Good             | Adulterated | Local              | Improved | Unaware                                         | Non Availability of POP | None |
| Bangalore | 80                    | 20         | 90       | 10         | 95               | 5           | 0                  | 100      | 25                                              | 15                      | 50   |
| Belgaum   | 90                    | 10         | 100      | 0          | 95               | 5           | 0                  | 100      | 50                                              | 25                      | 25   |
| Hassan    | 90                    | 10         | 85       | 15         | 100              | 0           | 0                  | 100      | 40                                              | 35                      | 25   |
| Hubli     | 85                    | 15         | 95       | 5          | 90               | 10          | 0                  | 100      | 25                                              | 30                      | 45   |
| Kolar     | 95                    | 5          | 90       | 10         | 100              | 0           | 0                  | 100      | 25                                              | 25                      | 50   |

were of good quality and adulterated seeds was uncommon. None of the farmers in the selected districts used local variety. Instead improved varieties like Kufri jyothi, Kufri chandramukhi etc., were preferred. Non awareness and non availability of Package of Practices (POP) books published by the Department of Agriculture and the Agricultural Universities were the major constraints in adoption of Package of practices in the selected districts. Non awareness about POP was highest in Belgaum followed by Hassan.

The sample farmers were asked the reasons for non production of uniform quality potato and results are presented in Table 4.8. According to majority of the farmers, the first tuber absorbs all the nutrients from the soil which resulted in subsequent tubers of smaller and non-uniform size. Non-uniform soil fertility was also quoted by the farmers for production of non-uniform tubers. Other reasons included non-uniform irrigation facility and non-uniform fertiliser application. However, as per the opinion of the five scientists at the university, the major reason for the production of non-uniform potato tuber is the inherent genetic makeup of the plant and the soil type in which potato is grown. Good quality potato can be cultivated in loose sandy loam soils which are best suited for growing potato. The scientists did not agree with the other reasons as responsible for the production of non-uniform quality of potato.

**Table 4.8. Reasons for not producing uniform size of produce****(in percentage)**

| Serial No. | Particulars                            | Farmers view | Scientist view |
|------------|----------------------------------------|--------------|----------------|
| 1          | Non uniform Irrigation                 | 10           | 5              |
| 2          | Non uniform fertiliser application     | 10           | 5              |
| 3          | Non uniform soil fertility             | 20           | 10             |
| 4          | First tubers absorbs all the nutrients | 60           | 10             |
| 5          | Genetic nature of plant                | 0            | 50             |
| 6          | Soil type                              | 0            | 20             |

#### **4.5 Gaps in the level of infrastructure facilities like storage, processing, transportation and marketing finance in potato.**

##### **4.5.1 Availability of infrastructure facilities at selected APMCs**

The infrastructure facilities at the APMCs considered for the study were availability of transportation and storage facility, space for keeping produce in the market yard, temporary storage structures, grading and physical facilities. The farmers were asked to give their opinion on the availability or otherwise of these facilities. The results are presented in Table 4.9. More than 70 per cent of the farmers in all the markets were satisfied with the transport facilities available in the markets. However, 30 per cent of the farmers in Belgaum and 25 per cent in Bangalore felt that the facilities were inadequate.

Regarding the adequacy of storage facilities, 50 per cent of the farmers felt it was adequate in Bangalore, Hassan and Kolar markets. While, in the two markets in Northern Karnataka viz., Belgaum and Hubli, majority of the farmers felt the facility was adequate.

Majority of the farmers (more than 55 per cent) in all the markets felt that the space provided by APMCs for keeping the produce for sale was inadequate. This calls for a serious consideration for expansion of space for sale in the APMC yards.

**Table 4.9. Farmers opinion about availability of infrastructure facilities at APMCs**

(in Percentages)

| Market    | Transportation facility |            | Storage facility |            | Space for keeping produce |            | Grading facility |             | Physical facility |            | Temporary storage facility |            |
|-----------|-------------------------|------------|------------------|------------|---------------------------|------------|------------------|-------------|-------------------|------------|----------------------------|------------|
|           | Adequate                | Inadequate | Adequate         | Inadequate | Adequate                  | Inadequate | Available        | Unavailable | Adequate          | Inadequate | Adequate                   | Inadequate |
| Bangalore | 75                      | 25         | 50               | 50         | 25                        | 75         | 30               | 70          | 60                | 40         | 45                         | 55         |
| Belgaum   | 70                      | 30         | 65               | 35         | 45                        | 55         | 40               | 60          | 50                | 50         | 25                         | 55         |
| Hassan    | 100                     | 0          | 50               | 50         | 30                        | 70         | 10               | 90          | 90                | 10         | 25                         | 75         |
| Hubli     | 100                     | 0          | 70               | 30         | 40                        | 60         | 35               | 65          | 60                | 40         | 55                         | 45         |
| Kolar     | 90                      | 10         | 55               | 45         | 30                        | 70         | 10               | 90          | 75                | 25         | 25                         | 75         |

Grading facility in all the markets was found wanting by most of the farmers. Ninety per cent of the farmers each in Hassan and Kolar markets and more than 60 per cent in other markets said that the facility is inadequate. This calls for improvement of grading facilities in the APMC yards. This would go a long way in helping the farmers to obtain remunerative prices for their produce.

The other physical facilities such as post office, bank, drinking water etc., were found to be adequate by more than 50 per cent of the farmers in all markets. However, in markets such as those in Belgaum, Bangalore and Hubli these facilities need to be strengthened to meet the needs of the farmers.

More than 55 per cent of the farmers in all markets except in Hubli have found the storage facility in the APMCs to be inadequate. This forces the farmers to sell their produce at whatever prices they get. Hence, there is a strong case for expanding storage facilities in the APMC yards.

#### **4.5.2 Farmers opinion on transaction facilities at selected APMCs**

Transaction facilities namely bidding, system of weighing, deductions at market, commission charges and payment of cash for produce were examined and presented in Table 4.10. Almost all the farmers in all the markets have expressed satisfaction over the facilities created in the APMCs for marketing of potato. It may be seen from the table that all the farmers in all the markets were satisfied with the



**Table 4.10. Farmers opinion on transaction facilities at selected APMCs**

(in Percentages)

| District  | Bidding           |                     | System of weighment |         | Deductions at market |         | Commission Charges |                   | Payment of cash for produce |           |
|-----------|-------------------|---------------------|---------------------|---------|----------------------|---------|--------------------|-------------------|-----------------------------|-----------|
|           | Satis-<br>factory | Unsatis-<br>factory | Faulty              | Correct | Legal                | Illegal | Reasonable         | Unrea-<br>sonable | Immediate                   | Prolonged |
| Bangalore | 100               | 0                   | 0                   | 100     | 100                  | 0       | 100                | 0                 | 98                          | 2         |
| Belgaum   | 100               | 0                   | 0                   | 100     | 100                  | 0       | 90                 | 10                | 100                         | 0         |
| Hassan    | 100               | 0                   | 0                   | 100     | 100                  | 0       | 95                 | 5                 | 100                         | 0         |
| Hubli     | 100               | 0                   | 10                  | 90      | 100                  | 0       | 90                 | 10                | 95                          | 5         |
| Kolar     | 100               | 0                   | 5                   | 95      | 100                  | 0       | 95                 | 5                 | 98                          | 2         |

bidding facilities provided. Similarly more than 90 per cent in all the markets felt that the system of weighing was correct. All the farmers in the five markets expressed that the deduction from payments were legal in nature and no illegal deductions were made. More than 90 per cent in the five markets felt that commission charges, which they do not have to pay, were reasonable. It was also seen that the payment of cash for the produce was satisfactory for more than 95 per cent of the farmers in all the markets. These results suggest that the regulations regarding the trading practices in the five APMCs have been strictly adhered to, and the farmers have no reason to complain about the trading practices.

#### **4.5.3 Marketing of potato by farmers**

Potato is mainly sold by farmers in the APMCs through commission agents. The reasons expressed by the farmers for selling through particular commission agents are presented in Table 4.11. A large number of farmers (more than 80 per cent) quoted immediate cash, receiving competitive prices, and lower marketing costs as the reasons for selling through particular commission agents in the selected markets. It was found that hardly any farmer had entered into previous agreement with intermediaries for selling the produce. None of the farmers were provided transportation facilities by the commission agents. All the farmers had received information on the market situation from the commission agents in all the markets. Advance loans for production were secured by a few farmers (more than 15 per cent) from commission agents in Belgaum, Hassan and Hubli markets. It was further seen that

**Table 4.11. Farmers reasons for selling potato through commission agents**

(in percentages)

| Serial No | Particulars                                 | Bangalore | Belgaum | Hassan | Hubli | Kolar |
|-----------|---------------------------------------------|-----------|---------|--------|-------|-------|
| 1.        | Previous agreements with the intermediary   | 5         | 0       | 0      | 0     | 5     |
| 2.        | Immediate cash payments                     | 95        | 90      | 95     | 100   | 90    |
| 3.        | Receive competitive prices (better prices)  | 100       | 90      | 95     | 95    | 100   |
| 4.        | Small quantity of produce for sale          | 50        | 40      | 55     | 40    | 60    |
| 5.        | Lack of information on marketing practices  | 5         | 15      | 10     | 5     | 10    |
| 6.        | Low marketing costs                         | 80        | 80      | 90     | 95    | 100   |
| 7.        | Social ties with the intermediary           | 5         | 10      | 05     | 10    | 10    |
| 8.        | Getting information on the market situation | 100       | 100     | 100    | 100   | 100   |
| 9.        | Advances loan for vegetables production     | 0         | 10      | 5      | 15    | 0     |
| 10.       | Getting storage facilities                  | 15        | 15      | 5      | 0     | 0     |
| 11.       | Getting transport facilities                | 0         | 0       | 0      | 0     | 0     |
| 12.       | Payments are made in advance                | 5         | 0       | 0      | 5     | 0     |

commission agents did not provide storage facilities to the farmers. It was seen that about half of the farmers preferred a particular agent for sale because of small quantity of the produce meaning that small quantity of produce is not a deterrent for approaching a commission agent. Less than 15 per cent of the farmers opined the lack of information about the marketing practices was a reason for sale through commission agents. This showed that the potato farmers were well informed of the marketing practices. The Table also reveals that a social tie with the commission agents is not the reason for selling through a particular commission agent which is good business ethics. The general belief that commission agents make advance payment to induce the farmers to approach them is defeated by the fact that hardly any farmer had received such advance payments.

#### **4.6 Constraints in utilisation of existing infrastructure**

Potatoes are stored in cold storage as well as in local storage structures. Storing the goods in cold storage is expensive for majority of small and medium farmers. There are 53 cold storages owned by private and cooperatives in Karnataka, of which 23 cold storages store potatoes along with other commodities, while only eight of these exclusively store potato. The commodities stored in cold storages include potato, apple, orange, tamarind, chilies, flowers, flower bulbs & seeds, milk, ice cream, dry & fresh fruits, peas, lemons, dry & fresh grape, vegetables and sunflower seeds.

**Table 4.12. Profile of cold storage units in Karnataka****( Capacity in MT)**

| Sl. No. | Name of the District | Number of cold storages | Capacity (MT) | Commodities stored                                       |
|---------|----------------------|-------------------------|---------------|----------------------------------------------------------|
| 1.      | Bangalore Urban      | 17                      | 18560         | Apple, orange, flower seeds and potato                   |
| 2.      | Bangalore Rural      | 1                       | 5000          | Potato, tamarind and other vegetables                    |
| 3.      | Kolar                | 9                       | 15150         | Potato, tamarind, apple and chilli                       |
| 4.      | Tumkur               | 1                       | 2800          | Potato, tamarind, vegetables and chilli                  |
| 5.      | Dharwad              | 3                       | 8100          | Potato, tamarind, vegetables and chilli                  |
| 6.      | Bagalkot             | 1                       | 1000          | Fruits and vegetables                                    |
| 7.      | Bijapur              | 5                       | 4500          | Tamarind and fresh lime fruits                           |
| 8.      | Hassan               | 3                       | 3620          | Potato and fruits                                        |
| 9.      | Bellary              | 3                       | 5500          | Red chilli, tamarind, eggs, pomegrante and lime          |
| 10.     | Belgaum              | 6                       | 5658          | Potato, tamarind, red chilli, jaggery, peas and turmeric |
| 11.     | Haveri               | 4                       | 16200         | Red chilli and tamarind seeds                            |
|         | <b>TOTAL</b>         | <b>53</b>               | <b>86088</b>  |                                                          |

The Table 4.12 presents the profile of cold storage units in Karnataka. The table shows that Bangalore district alone accounted for 33.96 per cent of the total number of cold storage units installed with a combined capacity of 27.37 per cent to the total cold storage capacity in the state. Kolar and Belgaum districts followed with a combined capacity of 24.17 per cent of total storage capacity. The largest potato producing district in Karnataka, Hassan accounted for a meager 4.20 per cent of the total storage capacity in the state.

A survey was conducted to study the pattern of potato storage by farmers in the study area. The utilization pattern of storage structures by the farmers are presented in Table 4.13. It may be seen from the table that majority of small farmers utilized local storage structures while 23 of the 52 large farmers utilized this facility. The cold storage structures were utilized by only 6 small farmers and 29 large farmers. The average quantity stored per farmer in local storage structures was higher in large size group of farmers (138 quintals) compared to small farmers who stored 75 quintals. The potato storage in the cold storage structures exhibited a wide range in the quantity stored per farmer between small and large farmers with the difference being 140 quintals per farmer. Fifteen of the small farmers did not store the potatoes they cultivated and marketed them immediately after harvest.

The number of farmers storing potato in local storage structures and cold storage structures and farmers who do not store potato are presented in Table 4.14. In the five districts under study, 45-55 per cent

**Table 4.13. Utilization pattern of storages by potato farmers****(Quantity in Quintals)**

| Farm size | Local storage structure |                           | Cold storage structure |                           | Farmers not storing |
|-----------|-------------------------|---------------------------|------------------------|---------------------------|---------------------|
|           | No. of farmers          | Average Qty Stored/farmer | No. of farmers         | Average Qty Stored/farmer |                     |
| Small     | 27<br>(54)              | 75                        | 6<br>(17.41)           | 60                        | 15                  |
| Large     | 23<br>(46)              | 138                       | 29<br>(82.86)          | 200                       | --                  |
| Total     | 50 (100)                | 106.5                     | 35 (100)               | 130                       | 15                  |

Figures in parenthesis indicate percentage to the total

**Table 4.14. Farmers behaviour in storing potato****(in per cent)**

| District  | Local storage | Cold storage | Not storing | Total |
|-----------|---------------|--------------|-------------|-------|
| Bangalore | 55            | 25           | 20          | 100   |
| Belgaum   | 55            | 25           | 20          | 100   |
| Dharwad   | 55            | 20           | 25          | 100   |
| Hassan    | 45            | 45           | 10          | 100   |
| Kolar     | 55            | 20           | 25          | 100   |



of the farmers stored potato in local storage structures. The percentage of farmers storing potato in cold storage structures in Hassan district was high at 45 per cent compared to 20-25 per cent in other districts. The percentage of farmers who do not store potato was minimum in Hassan (10 per cent) compared to 20- 25 per cent in other districts.

#### **4.6.1 Cost of construction of storage structures**

The costs of establishment of storage structures are presented in Tables 4.15 and 4.16. It may be seen that the cost of establishment of local storage structures with 80 quintals capacity amounted to Rs.. 4100 (Table 4.15). The cost of tarpaulin accounted for 60.97 per cent of the total, while bamboo and other wooden materials accounted for 29.23 per cent and labour charges accounted for 9.76 per cent. The cost of tarpaulin was apportioned at 10 per cent of the actual cost on an annual basis for a life period of 10 years.

The cost of establishment of a cold storage unit with 25000 quintals capacity is shown in Table 4.16, from which it may be seen that among the major items of cost, building and refrigeration plant accounted for nearly 76.10 per cent of the total cost of establishment, followed by cost of electrification and diesel generator. The total cost involved in establishing a 25000 quintal capacity cold storage unit was Rs.176.08 lakhs.

The cost and returns in different storage structures for owners are presented in Table 4.17. The net return was calculated based on the

**Table 4.15. Establishment cost of local storage structure**

| (Capacity: 80 Qtl) |                                 |                   |
|--------------------|---------------------------------|-------------------|
| Sl. No.            | Item                            | Cost (Rs)         |
| 1.                 | Covering Material (Tarpaulin)   | 2500 (60.97)      |
| 2.                 | Bamboo & other wooden materials | 1200 (29.27)      |
| 3                  | Labour charges                  | 400 (9.76)        |
|                    | <b>Total</b>                    | <b>4100 (100)</b> |

Figures in parenthesis indicate percentage to the total

**Table 4.16. Establishment cost of Cold storage structure**

(Capacity: 25000 Qtl)

| Sl.No. | Item                                      | Amount (Rs. in Lakhs)  |
|--------|-------------------------------------------|------------------------|
| 1.     | Land                                      | 1.10 (0.62)            |
| 2 a    | Buildings                                 | 92.00 (52.25)          |
| b      | Boundary wall, site development and roads | 4.50 (2.56)            |
| c      | Condenser Tank and machine foundation     | 2.50 (1.42)            |
| d      | Water supply including tube well          | 2.75 (1.56)            |
| e      | Refrigeration plant and insulation system | 42.00 (23.85)          |
| f      | Architects fee and supervision charges    | 2.40 (1.36)            |
| 3.     | Electrification                           | 12.00 (6.82)           |
| 4.     | Diesel Engine                             | 6.00 (3.41)            |
| 5.     | Other fixed assets                        | 0.33 (0.91)            |
| 6.     | Pre-operative expenses                    | 2.50 (1.42)            |
| 7.     | Margin money                              | 3.00 (1.70)            |
| 8.     | Hoist                                     | 5.00 (2.84)            |
|        | <b>Total</b>                              | <b>176.08 (100.00)</b> |

Figures in parenthesis indicate percentage to the total

assumption that local structure would be let out for hiring at the rate of Rs.16 per quintal per month. The net return so obtained was Rs..730.

Similarly, the cost and returns in cold storage structure with 25,000 quintals capacity was calculated. The total cost per month (both apportioned fixed and variable cost) worked out to be Rs.96,860 while the maintenance cost accounted for Rs.33,81,013 while the net returns was found to be Rs.6,18,986 per year.

Table 4.18, represents the costs for cold storage and local storage structure per month. It was observed from the Table 4.18, that in the local storage structures with a capacity of 80 quintals, the labor charges for watch and ward charges alone contributed to 100 per cent of the total cost.

The costs for cold storage structures were calculated separately for peak and lean seasons. Peak season costs were for 5 months in a year, while lean season lasted for 7 months. Among the different items of costs in the cold storage structure, electricity component took away a large portion of the total cost accounting for 56 per cent and 19.33 per cent during peak and lean season, respectively. The establishment charges and insurance were identical in both seasons at Rs15000 each. The maintenance cost and repayment of loan accounted for higher percentages to the total cost in lean season compared to those in the peak season. The net difference in total cost between peak and lean seasons worked out to Rs.1,38,000 per month.

**Table 4.17. Cost and returns in different storage structure for owners**

| Different storage structures | Capacity In qtl | Apportioned cost of construction | Maintenance Cost | Storage Period months | Total cost | Returns * | (Rs/year)   |  |
|------------------------------|-----------------|----------------------------------|------------------|-----------------------|------------|-----------|-------------|--|
|                              |                 |                                  |                  |                       |            |           | Net returns |  |
| Local (Heap)                 | 80              | 410                              | 2700             | 3                     | 3110       | 3840      | 730         |  |
| Cold storage                 | 25000           | 704000                           | 2677014          | 5                     | 3381013.64 | 4000000   | 618986.36   |  |

Note:\* Based on the assumption that the local storage structure is let out for hiring @ Rs 16/ qtl/month

Figures in parenthesis indicate percentage to the total

**Table 4.18 Cost in storage structures**

| Items                     | Local storage structure<br>(Rs/month) for<br>80 quintals capacity | Cold storage structure<br>(Rs/month) for 25,000 quintals<br>capacity |                       |
|---------------------------|-------------------------------------------------------------------|----------------------------------------------------------------------|-----------------------|
|                           |                                                                   | Peak season                                                          | Lean season           |
| Electricity               | -----                                                             | 170000<br>(56.00)                                                    | 32000<br>(19.33)      |
| Maintenance               | -----                                                             | 40000<br>(13.18)                                                     | 40000<br>(24.16)      |
| Watch and ward<br>charges | 900<br>(100)                                                      | -----                                                                | -----                 |
| Establishment<br>charges  |                                                                   | 15000<br>(4.94)                                                      | 15000<br>(9.06)       |
| Repayment of loan *       | -----                                                             | 63584.47<br>(20.94)                                                  | 63584.47<br>(38.40)   |
| Insurance                 | -----                                                             | 15000<br>(4.94)                                                      | 15000<br>(9.06)       |
| Total                     | 900<br>(100)                                                      | 303584.47<br>(100.00)                                                | 165584.47<br>(100.00) |

\*Loan repayment for the first 10 years only.

Figures in parenthesis indicate percentage to the total

**4.6.2.1 Financial feasibility of investing in cold storage structures**

The financial feasibility of investing in local storage structure and cold storage was determined by using the standard techniques like Net Present Value (NPV), Benefit Cost Ratio (BCR), Internal Rate of Return (IRR) and Pay Back Period (PBP). The financial feasibility for cold storage structures worked out on the total capacity utilisation per year while in the case of local storage structure, the net price difference received per quintal 1, 2, and 3 months after storage was the basis for calculating the returns from storage. The lifespan of the cold storage unit was considered as 25 years while that of the local storage structure was for 10 years. The cash outflow in the cold storage structure was different for the first 10 years on account of loan repayment. Sensitivity analysis were carried out on the financial feasibilities at 42 per cent (existing), 50 per cent 60 percent and 70 per cent capacity utilization to indicate at which level of capacity utilization the investments are feasible .The results are presented in Tables 4.19 to 4.22.

Table 4.19, presents the cash flow statement for cold storage units running at 42 per cent capacity utilisation. The net cash flow for the first 10 years varied due to the varying cash outflow on account of the repayment of loan of Rs.70.40 lakhs. The net cash flow showed an increasing trend over the years .

**Table 4.19. Cash flows in cold storage structures running at 42 per cent capacity utilisation \***

**(Amount in Rs)**

| Year | Cash outflow | Cash Inflows | Net Cash flow | Discounting factor at 10 % | Net Discounted Cash flow |
|------|--------------|--------------|---------------|----------------------------|--------------------------|
| 0    | 17600000     |              |               |                            |                          |
| 1    | 2023217      | 4000000      | 1976783       | 0.9090                     | 1796896                  |
| 2    | 2012546      | 4000000      | 1987454       | 0.8264                     | 1642432                  |
| 3    | 2001701      | 4000000      | 1998299       | 0.7513                     | 1501322                  |
| 4    | 1990679      | 4000000      | 2009321       | 0.6830                     | 1372366                  |
| 5    | 1979477      | 4000000      | 2020523       | 0.6209                     | 1254543                  |
| 6    | 1968092      | 4000000      | 2031908       | 0.5645                     | 1147012                  |
| 7    | 1956521      | 4000000      | 2043479       | 0.5132                     | 1048713                  |
| 8    | 1944762      | 4000000      | 2055238       | 0.4665                     | 958769                   |
| 9    | 1934769      | 4000000      | 2065231       | 0.4241                     | 875865                   |
| 10   | 1918702      | 4000000      | 2081298       | 0.3855                     | 802340                   |
| 11   | 1914000      | 4000000      | 2086000       | 0.3505                     | 731143                   |
| 12   | 1914000      | 4000000      | 2086000       | 0.3186                     | 664600                   |
| 13   | 1914000      | 4000000      | 2086000       | 0.2897                     | 604314                   |
| 14   | 1914000      | 4000000      | 2086000       | 0.2633                     | 549244                   |
| 15   | 1914000      | 4000000      | 2086000       | 0.2394                     | 499388                   |
| 16   | 1914000      | 4000000      | 2086000       | 0.2176                     | 453914                   |
| 17   | 1914000      | 4000000      | 2086000       | 0.1978                     | 412611                   |



**Table 4.19: Cont'd**

|    |         |         |         |        |                 |
|----|---------|---------|---------|--------|-----------------|
| 18 | 1914000 | 4000000 | 2086000 | 0.1798 | 375063          |
| 19 | 1914000 | 4000000 | 2086000 | 0.1635 | 341061          |
| 20 | 1914000 | 4000000 | 2086000 | 0.1486 | 309980          |
| 21 | 1914000 | 4000000 | 2086000 | 0.1351 | 281819          |
| 22 | 1914000 | 4000000 | 2086000 | 0.1228 | 256161          |
| 23 | 1914000 | 4000000 | 2086000 | 0.1117 | 233006          |
| 24 | 1914000 | 4000000 | 2086000 | 0.1015 | 211729          |
| 25 | 1914000 | 4000000 | 2086000 | 0.0923 | 192538          |
|    |         |         |         |        | <b>18516829</b> |

\* Storage of only potato during peak season

**Table 4.20: Cash flows in cold storage structures running at 50 per cent capacity utilisation**

(Amount in Rs)

| Year | Cash outflow | Cash Inflows | Net Cash flow | Discounting factor at 10 % | Net Discounted Cash flow |
|------|--------------|--------------|---------------|----------------------------|--------------------------|
| 0    | 17600000     |              |               |                            |                          |
| 1    | 2161217      | 4800000      | 2638783       | 0.9090                     | 2398654                  |
| 2    | 2150546      | 4800000      | 2649454       | 0.8264                     | 2189509                  |
| 3    | 2139701      | 4800000      | 2660299       | 0.7513                     | 1998683                  |
| 4    | 2128679      | 4800000      | 2671321       | 0.6830                     | 1824512                  |
| 5    | 2117477      | 4800000      | 2682523       | 0.6209                     | 1665579                  |
| 6    | 2106092      | 4800000      | 2693908       | 0.5645                     | 1520711                  |
| 7    | 2094521      | 4800000      | 2705479       | 0.5132                     | 1388452                  |
| 8    | 2082762      | 4800000      | 2717238       | 0.4665                     | 1267592                  |
| 9    | 2072769      | 4800000      | 2727231       | 0.4241                     | 1156619                  |
| 10   | 2056702      | 4800000      | 2743298       | 0.3855                     | 1057541                  |
| 11   | 2052000      | 4800000      | 2748000       | 0.3505                     | 963174                   |
| 12   | 2052000      | 4800000      | 2748000       | 0.3186                     | 875513                   |
| 13   | 2052000      | 4800000      | 2748000       | 0.2897                     | 796096                   |
| 14   | 2052000      | 4800000      | 2748000       | 0.2633                     | 723548                   |
| 15   | 2052000      | 4800000      | 2748000       | 0.2394                     | 657871                   |
| 16   | 2052000      | 4800000      | 2748000       | 0.2176                     | 597965                   |
| 17   | 2052000      | 4800000      | 2748000       | 0.1978                     | 543554                   |

Table 4.20: Cont'd

|    |         |         |         |        |                 |
|----|---------|---------|---------|--------|-----------------|
| 18 | 2052000 | 4800000 | 2748000 | 0.1798 | 494090          |
| 19 | 2052000 | 4800000 | 2748000 | 0.1635 | 449298          |
| 20 | 2052000 | 4800000 | 2748000 | 0.1486 | 408353          |
| 21 | 2052000 | 4800000 | 2748000 | 0.1351 | 371255          |
| 22 | 2052000 | 4800000 | 2748000 | 0.1228 | 337454          |
| 23 | 2052000 | 4800000 | 2748000 | 0.1117 | 306952          |
| 24 | 2052000 | 4800000 | 2748000 | 0.1015 | 278922          |
| 25 | 2052000 | 4800000 | 2748000 | 0.0923 | 253640          |
|    |         |         |         |        | <b>24525537</b> |

**Table 4.21. Cash flows in cold storage structures running at 60 per cent capacity utilisation**

(Amount in Rs)

| Year | Cash outflow | Cash Inflows | Net Cash flow | Discounting factor at 10 % | Net Discounted Cash flow |
|------|--------------|--------------|---------------|----------------------------|--------------------------|
| 0    | 17600000     |              |               |                            |                          |
| 1    | 2299217      | 5600000      | 3300783       | 0.9090                     | 3000412                  |
| 2    | 2288546      | 5600000      | 3311454       | 0.8264                     | 2736586                  |
| 3    | 2277701      | 5600000      | 3322299       | 0.7513                     | 2496043                  |
| 4    | 2266679      | 5600000      | 3333321       | 0.6830                     | 2276658                  |
| 5    | 2255477      | 5600000      | 3344523       | 0.6209                     | 2076614                  |
| 6    | 2244092      | 5600000      | 3355908       | 0.5645                     | 1894410                  |
| 7    | 2232521      | 5600000      | 3367479       | 0.5132                     | 1728190                  |
| 8    | 2220762      | 5600000      | 3379238       | 0.4665                     | 1576415                  |
| 9    | 2210769      | 5600000      | 3389231       | 0.4241                     | 1437373                  |
| 10   | 2194702      | 5600000      | 3405298       | 0.3855                     | 1312742                  |
| 11   | 2190000      | 5600000      | 3410000       | 0.3505                     | 1195205                  |
| 12   | 2190000      | 5600000      | 3410000       | 0.3186                     | 1086426                  |
| 13   | 2190000      | 5600000      | 3410000       | 0.2897                     | 987877                   |
| 14   | 2190000      | 5600000      | 3410000       | 0.2633                     | 897853                   |
| 15   | 2190000      | 5600000      | 3410000       | 0.2394                     | 816354                   |
| 16   | 2190000      | 5600000      | 3410000       | 0.2176                     | 742016                   |
| 17   | 2190000      | 5600000      | 3410000       | 0.1978                     | 674498                   |

**Table 4.21: Cont'd**

|    |         |         |         |        |                 |
|----|---------|---------|---------|--------|-----------------|
| 18 | 2190000 | 5600000 | 3410000 | 0.1798 | 613118          |
| 19 | 2190000 | 5600000 | 3410000 | 0.1635 | 557535          |
| 20 | 2190000 | 5600000 | 3410000 | 0.1486 | 506726          |
| 21 | 2190000 | 5600000 | 3410000 | 0.1351 | 460691          |
| 22 | 2190000 | 5600000 | 3410000 | 0.1228 | 418748          |
| 23 | 2190000 | 5600000 | 3410000 | 0.1117 | 380897          |
| 24 | 2190000 | 5600000 | 3410000 | 0.1015 | 346115          |
| 25 | 2190000 | 5600000 | 3410000 | 0.0923 | 314743          |
|    |         |         |         |        | <b>30534245</b> |

**Table 4.22. Cash flows in cold storage structures running at 70 per cent capacity utilisation**

(Amount in Rs)

| Year | Cash outflow | Cash Inflows | Net Cash flow | Discounting factor at 10 % | Net Discounted Cash flow |
|------|--------------|--------------|---------------|----------------------------|--------------------------|
| 0    | 17600000     |              |               |                            |                          |
| 1    | 2437217      | 6400000      | 3962783       | 0.9090                     | 3602170                  |
| 2    | 2426546      | 6400000      | 3973454       | 0.8264                     | 3283662                  |
| 3    | 2415701      | 6400000      | 3984299       | 0.7513                     | 2993404                  |
| 4    | 2404679      | 6400000      | 3995321       | 0.6830                     | 2728804                  |
| 5    | 2393477      | 6400000      | 4006523       | 0.6209                     | 2487650                  |
| 6    | 2382092      | 6400000      | 4017908       | 0.5645                     | 2268109                  |
| 7    | 2370521      | 6400000      | 4029479       | 0.5132                     | 2067928                  |
| 8    | 2358762      | 6400000      | 4041238       | 0.4665                     | 1885238                  |
| 9    | 2348769      | 6400000      | 4051231       | 0.4241                     | 1718127                  |
| 10   | 2332702      | 6400000      | 4067298       | 0.3855                     | 1567943                  |
| 11   | 2328000      | 6400000      | 4072000       | 0.3505                     | 1427236                  |
| 12   | 2328000      | 6400000      | 4072000       | 0.3186                     | 1297339                  |
| 13   | 2328000      | 6400000      | 4072000       | 0.2897                     | 1179658                  |
| 14   | 2328000      | 6400000      | 4072000       | 0.2633                     | 1072158                  |
| 15   | 2328000      | 6400000      | 4072000       | 0.2394                     | 974837                   |
| 16   | 2328000      | 6400000      | 4072000       | 0.2176                     | 886067                   |
| 17   | 2328000      | 6400000      | 4072000       | 0.1978                     | 805442                   |

**Table 4.22: Cont'd**

|    |         |         |         |        |                 |
|----|---------|---------|---------|--------|-----------------|
| 18 | 2328000 | 6400000 | 4072000 | 0.1798 | 732146          |
| 19 | 2328000 | 6400000 | 4072000 | 0.1635 | 665772          |
| 20 | 2328000 | 6400000 | 4072000 | 0.1486 | 605099          |
| 21 | 2328000 | 6400000 | 4072000 | 0.1351 | 550127          |
| 22 | 2328000 | 6400000 | 4072000 | 0.1228 | 500042          |
| 23 | 2328000 | 6400000 | 4072000 | 0.1117 | 454842          |
| 24 | 2328000 | 6400000 | 4072000 | 0.1015 | 413308          |
| 25 | 2328000 | 6400000 | 4072000 | 0.0923 | 375846          |
|    |         |         |         |        | <b>36542954</b> |

The cash flow statement for cold storage units at 50 per cent capacity utilisation is presented in Table 4.20. The cash out flow showed a decreasing trend. The net cash flow was Rs.26.39 lakhs in the first year which subsequently increased to Rs.27.48 lakhs in the 25<sup>th</sup> year.

The cash flows for cold storage unit running under 60 per cent capacity utilisation are presented in Table 4.21. The Net cash flow increased from Rs.33,00,783 in the first year to Rs.34,10,000 in the 25<sup>th</sup> year

The net discounted cash flow at the end of the 25<sup>th</sup> year was found to be about Rs.3.65 crores for cold storages running at 70 per cent capacity utilisation Table 4.22. The cash out flow and the discounted net cash flow represented a falling trend while the net cash flow increased over time.

#### **4.6.2.2 Evaluation of investments in cold storage structure**

The results of the financial feasibility analysis for different levels of capacity utilisation of cold storage using the criteria of Net Present Value (NPV), Benefit Cost Ratio (BCR), Internal Rate of Return (IRR) and Pay Back Period (PBP) are presented in Table 4.23. All the results of the techniques presented positive and increasing returns for increased capacity utilisation.



**Table 4.23. Evaluation of investment in cold storage structure at various levels of capacity utilisation (CU)**

| Sl. No. | Particulars                          | 42 % CU (Existing) | 50 % CU   | 60 % CU   | 70 % CU   |
|---------|--------------------------------------|--------------------|-----------|-----------|-----------|
| 1       | Net present value (NPV) (Rs in lakh) | 916829             | 6925537   | 12934246  | 18942955  |
| 2       | Benefit Cost ratio (BCR)             | 1.05               | 1.39      | 1.73      | 2.08      |
| 3       | Internal Rate of Return (IRR)        | 10.68 %            | 15.85%    | 24.09%    | 25.67%    |
| 4       | Pay Back period (PBP)                | 8.9 years          | 6.8 years | 5.4 years | 4.6 years |

Note: CU = Capacity utilisation

#### **a) Net present Value (NPV)**

160

The annual net cash flow was discounted at a discount rate of 10 per cent to obtain the present value of net benefits for investing in cold storages. The discount rate was considered on the basis of the falling interest rates on deposits and loans in the recent past.

It can be seen from Table 4.23, that the NPV was Rs.9.17 lakhs at 42 per cent, Rs.69.25 lakhs at 50 per cent, Rs.1.29 crores at 60 per cent and Rs.1.89 crores at 70 per cent capacity utilization. Thus the investment was financially feasible at all levels of capital utilization.

#### **b) Benefit Cost Ratio (BCR)**

This criterion indicates the net returns per rupee invested in the cold storage. From Table 4.23, it can be seen that the BCR was 1.05 at 42 per cent capacity utilisation which subsequently increased to 1.39, 1.73 and 2.08 at 50 per cent, 60 per cent and 70 per cent capacity utilization, respectively. The results showed that running cold storages at higher capacity utilisation was more profitable than running under lower capacity utilisation. However, since at all levels of capacity utilisation the BCR was greater than unity, it could be concluded that the investment in cold storage units is financially feasible and economically viable.

### c) Internal rate of Return (IRR)

This criterion measures the rate of returns that can be earned by investing in cold storage units. It also considers the reinvestment opportunities absent in other techniques.

From the Table 4.23, it could be concluded that the existing level of capacity utilisation of 42 per cent was unviable as it had a lower IRR than the existing market rate of 13.5 per cent. The NCDC advances loans at 13.5 per cent to the persons interested in starting cold storage units. However, IRR increased from 15.85 per cent at 50 per cent capacity utilization to 25.67 per cent at 70 per cent capacity utilisation, thus indicating that investment is feasible at 50 per cent capacity utilization and more.

### d) Pay Back Period (PBP)

The time required to recover the initial investment is indicated by the pay back period. The Pay Back Period for 42 per cent capacity utilisation was 8.9 years which reduced to 4.6 years on increasing the capacity utilisation to 70 per cent, indicating lower pay back period on increased capacity utilisation.

#### 4.6.2.3 Financial feasibility of investing in local storage structures

Local storage structures are popular among farmers for storage of potato, hence financial feasibility analysis were conducted for the same. Local structures were evaluated on the basis of returns earned per

**Table 4.24. Price difference of potato crop in Kharif and rabi season at different Months After Harvest (MAH)**

| Sl no. | Particulars   | At harvest<br>Rs / quintal | 1 MAH<br>Rs / quintal | 2 MAH<br>Rs / quintal | 3 MAH<br>Rs / quintal |
|--------|---------------|----------------------------|-----------------------|-----------------------|-----------------------|
| 1      | Kharif season | 459                        | 454                   | 452                   | 378                   |
| 2      | Rabi season   | 320                        | 381                   | 440                   | 491                   |

quintal at the end of storage period. Table 4.24, presents the five year average price difference of potato crop during kharif and rabi seasons at different durations of storage. From the table it may be seen that during the kharif season the price decreased from the time of harvest, Rs.459 per quintal to Rs.378 per quintal at the end of three months after harvest. Hence, it could be concluded that potato should be sold immediately on harvest during kharif season. Hence, financial feasibility of potato storage during the kharif season for local storage structures was not worked out as negative returns were obtained on storing potato.

The price for rabi crop, however, showed an increasing trend, increasing from Rs.320 at the time of harvest to Rs.491 at three months after harvest. Thus the results suggest storing potato during rabi season is advisable.

Table 4.25, shows the cash flows on investing in local storage structures when potato is stored for one month during rabi season. The total net discounted cash flow at the end of 10 years was Rs.21,934.

Table 4.26, shows the cash flows in local storage structures for potato stored up to two months after harvest during rabi season. The total net discounted cash flow at the end of the 10<sup>th</sup> year was Rs.45,407.

From Table 4.27, it may be seen that the total net discounted cash flow at the end of the 10<sup>th</sup> year was Rs.64,947 in the local storage structures for potato stored for three months after harvest during rabi season.

**Table 4.25. Cash flows in local storage for potato stored for one month after harvest**

| <b>(Amount in Rs)</b> |                     |                     |                      |                                   |                                 |
|-----------------------|---------------------|---------------------|----------------------|-----------------------------------|---------------------------------|
| <b>Year</b>           | <b>Cash outflow</b> | <b>Cash Inflows</b> | <b>Net Cash flow</b> | <b>Discounting factor at 10 %</b> | <b>Net Discounted Cash flow</b> |
| 0                     | 4100                |                     |                      |                                   |                                 |
| 1                     | 1310                | 4880                | 3570                 | 0.9090                            | 3245                            |
| 2                     | 1310                | 4880                | 3570                 | 0.8264                            | 2950                            |
| 3                     | 1310                | 4880                | 3570                 | 0.7513                            | 2682                            |
| 4                     | 1310                | 4880                | 3570                 | 0.6830                            | 2438                            |
| 5                     | 1310                | 4880                | 3570                 | 0.6209                            | 2217                            |
| 6                     | 1310                | 4880                | 3570                 | 0.5645                            | 2015                            |
| 7                     | 1310                | 4880                | 3570                 | 0.5132                            | 1832                            |
| 8                     | 1310                | 4880                | 3570                 | 0.4665                            | 1665                            |
| 9                     | 1310                | 4880                | 3570                 | 0.4241                            | 1514                            |
| 10                    | 1310                | 4880                | 3570                 | 0.3855                            | 1376                            |
|                       |                     |                     |                      |                                   | <b>21934</b>                    |

**Table 4.26. Cash flows in local storage for potato stored for two month after harvest**

**(Amount in Rs)**

| Year | Cash outflow | Cash Inflows | Net Cash flow | Discounting factor at 10 % | Net Discounted Cash flow |
|------|--------------|--------------|---------------|----------------------------|--------------------------|
| 0    | 4100         |              |               |                            |                          |
| 1    | 2210         | 9600         | 7390          | 0.9090                     | 6718                     |
| 2    | 2210         | 9600         | 7390          | 0.8264                     | 6107                     |
| 3    | 2210         | 9600         | 7390          | 0.7513                     | 5552                     |
| 4    | 2210         | 9600         | 7390          | 0.6830                     | 5047                     |
| 5    | 2210         | 9600         | 7390          | 0.6209                     | 4588                     |
| 6    | 2210         | 9600         | 7390          | 0.5645                     | 4172                     |
| 7    | 2210         | 9600         | 7390          | 0.5132                     | 3793                     |
| 8    | 2210         | 9600         | 7390          | 0.4665                     | 3447                     |
| 9    | 2210         | 9600         | 7390          | 0.4241                     | 3134                     |
| 10   | 2210         | 9600         | 7390          | 0.3855                     | 2849                     |
|      |              |              |               |                            | <b>45407</b>             |

**Table 4.27. Cash outflows and inflows in local storage for potato stored for three month after harvest**

| <b>(Amount in Rs)</b> |                     |                     |                      |                                   |                                 |
|-----------------------|---------------------|---------------------|----------------------|-----------------------------------|---------------------------------|
| <b>Year</b>           | <b>Cash outflow</b> | <b>Cash Inflows</b> | <b>Net Cash flow</b> | <b>Discounting factor at 10 %</b> | <b>Net Discounted Cash flow</b> |
| 0                     | 4100                |                     |                      |                                   |                                 |
| 1                     | 3110                | 13680               | 10570                | 0.9090                            | 9608                            |
| 2                     | 3110                | 13680               | 10570                | 0.8264                            | 8735                            |
| 3                     | 3110                | 13680               | 10570                | 0.7513                            | 7941                            |
| 4                     | 3110                | 13680               | 10570                | 0.6830                            | 7219                            |
| 5                     | 3110                | 13680               | 10570                | 0.6209                            | 6563                            |
| 6                     | 3110                | 13680               | 10570                | 0.5645                            | 5967                            |
| 7                     | 3110                | 13680               | 10570                | 0.5132                            | 5425                            |
| 8                     | 3110                | 13680               | 10570                | 0.4665                            | 4931                            |
| 9                     | 3110                | 13680               | 10570                | 0.4241                            | 4483                            |
| 10                    | 3110                | 13680               | 10570                | 0.3855                            | 4075                            |
|                       |                     |                     |                      |                                   | <b>64947</b>                    |



#### 4.6.2.4 Evaluation of investment in local storage structure

The results of the financial feasibility analysis of local storage structures for different months of storage were studied using the criteria of Net Present Value (NPV), Benefit Cost Ratio (BCR), Internal Rate of Return and Pay Back Period (PBP). The results are presented in Table 4.28.

##### a) Net present Value (NPV)

The annual net cash flow was discounted at a discount rate of 10 per cent to obtain the present value of net benefits for investing in local storages.

It can be seen from Table 4.28, that the NPV was Rs.17,836 if potatoes are stored for one month, which increased to Rs.41,307 and Rs.60,846 on storing for two and three months, respectively. The results indicated that the investment was feasible irrespective of the period of storage of the commodity.

##### b) Benefit Cost Ratio (BCR)

This criterion indicates the net returns per rupee invested in the storage structure. From Table 4.28, it may be seen that, the BCR was 5.35 when potato was stored for one month which subsequently increased to 11.07 and 15.84 on storing potato for two and three months, respectively. The results showed that storing potato for longer duration under conditions of increasing prices was feasible. However, since the

**Table 4.28. Evaluation of investment in local storage structure at subsequent months after harvest for rabi season potato crop.**

| Sl. No. | particulars                      | Duration of storage |           |          |         |
|---------|----------------------------------|---------------------|-----------|----------|---------|
|         |                                  | At harvest          | 1 MAH     | 2 MAH    | 3 MAH   |
| 1       | Price in Rs / quintal            | 320                 | 381       | 440      | 491     |
| 2       | Net present value (NPV) (in Rs ) |                     | 17836     | 41307    | 60846   |
| 3       | Benefit Cost ratio (BCR)         |                     | 5.35      | 11.07    | 15.84   |
| 4       | Internal Rate of Return (IRR)    |                     | 87 %      | 180 %    | 258 %   |
| 5       | Pay Back period (PBP)            |                     | 1.2 years | 7 months | 5 month |

BCR was greater than unity, for all the duration of storage under study, it could be concluded that the investment in local storage units is financially feasible and economically viable during rabi season.

**c) Internal rate of Return (IRR)**

From Table 4.28, it can be seen that higher IRR was achieved on storing potato in local storage structures for longer duration. The IRR increased from 87 per cent for one month storage to 258 per cent for three months storage duration. Since, the IRR was greater than the ruling interest rate in all the cases, the investments were feasible.

**d) Pay Back Period (PBP)**

The time required to recover the initial investment is indicated by the pay back period. The Pay Back Period in local storage structures for storage of potato for one month was 1.2 years which decreased to five months on storing potato for three months on account of higher net returns obtained on storing potato for three months. Hence, higher duration of storage resulted in recovering the initial investment quickly.

### **4.6.3 Cost of storage**

The cost incurred on storage of potato by the farmers in Kharif season in cold and local storage structures is presented in Table 4.29. It may be observed that the total storage charges in the cold storage structure was of Rs.75 per quintal compared to those in the local storage structure at Rs.73 per quintal. Among the different components of cost,

**Table 4.29. Cost of storage of potato in kharif season****(Rs per qtl per month)**

| Item                                                                                                           | Cold storage          | Local storage         |
|----------------------------------------------------------------------------------------------------------------|-----------------------|-----------------------|
| Loading & unloading charges at farm and storage unit                                                           | 4.00 (5.33)           | ---                   |
| Transportation charges from farm to storage unit                                                               | 4.00 (5.33)           | ---                   |
| Losses during handling, storage & transit @ 5 per cent in cold storage and 10 per cent losses in local storage | 22.95 (30.61)         | 45.90 (62.92)         |
| Transportation charges from storage unit to market                                                             | 3.00 (4.00)           | 5.00 (6.85)           |
| Charges for loading & unloading at storage unit and market                                                     | 4.00 (5.33)           | 4.00 (5.48)           |
| Storage charges for 1 month                                                                                    | 32.00 (42.67)         | 13.00 (17.82)         |
| Interest on working capital                                                                                    | 5.05 (6.73)           | 5.05 (6.92)           |
| <b>Total</b>                                                                                                   | <b>75.00 (100.00)</b> | <b>72.95 (100.00)</b> |

Figures in parenthesis indicate percentage to the total

the storage charges for one month was Rs.32 per quintal under the cold storage structure accounting for 43 per cent of the total cost. This followed by the losses in handling, storage and transit which accounted for 31 per cent. The other items of cost like loading and unloading charges, transportation etc., formed less than 16 per cent of the total cost of storage.

In the case of local storage structure, the major component of cost was contributed by the losses during handling, storage and transit, which accounted for 62.92 per cent. This was followed by storage charges accounting for 17.82 per cent. Transportation charges and interest on working capital accounted for 13.78 per cent of the total cost. A comparative view of storage in the two-storage structures revealed that the storage charges and losses during storage, handling and transit accounted for a large share of cost in the storage of potato during the kharif season.

During the rabi season, the total cost of storage under cold storage structure was of Rs.66.52 per quintal (Table 4.30) compared to that in the local storage structure (Rs.57.52 per quintal). Among the different components of cost, the storage charges for one month was found to be Rs.32 per quintal accounting for 48.11 per cent of the total cost in the cold storage structure. This was followed by the losses in handling, storage and transits to an extent of 24.05 per cent. The other items of costs like loading and unloading charges, transportation etc., formed less than 24 per cent of the total cost of storage.

**Table 4.30. Cost of storage of potato in rabi season****(Rs per qtl per month)**

| Item                                                                                                           | Cold storage          | Local storage         |
|----------------------------------------------------------------------------------------------------------------|-----------------------|-----------------------|
| Loading & unloading charges at farm and storage unit                                                           | 4.00 (6.01)           | ---                   |
| Transportation charges from farm to storage unit                                                               | 4.00 (6.01)           | ---                   |
| Losses during handling, storage & transit @ 5 per cent in cold storage and 10 per cent losses in local storage | 16.00 (24.05)         | 32.00 (55.63)         |
| Transportation charges from storage unit to market                                                             | 3.00 (4.51)           | 5.00 (8.69)           |
| Charges for loading & unloading storage unit and market                                                        | 4.00 (6.01)           | 4.00 (6.95)           |
| Storage charges for 1 month                                                                                    | 32.00 (48.11)         | 13.00 (22.60)         |
| Interest on working capital                                                                                    | 3.52 (5.30)           | 3.52 (6.12)           |
| <b>Total</b>                                                                                                   | <b>66.52 (100.00)</b> | <b>57.52 (100.00)</b> |

Figures in parenthesis indicate percentage to the total

In the case of local storage structure, the major component of cost was by the losses during handling, storage and transit (55.63 per cent), followed by storage charges accounting for 22.60 per cent, transportation charges (8.69 per cent) and interest on working capital (6.12 per cent). A comparative analysis of the two-storage structures revealed that the storage charges and losses occupy a major cost item in the storage of potato during the rabi season.

Table 4.31 and Table 4.32, show the total cost incurred by potato farmers in storing potato in cold storage and local storage structures during kharif and rabi seasons, respectively. The Tables, present the total storage cost incurred for three months in succession.

Table 4.31, indicates that although farmers practicing storage in local storage structure saved on transportation and handling charges to the extent of 10.66 per cent during kharif season compared to cold storage unit, the total cost incurred in the storage in local storage structure was just Rs.2 per quintal cheaper than the cost of cold storage. The total cost incurred for storage in the second month was identically equal in both the structures, while in third month of storage in the cold storage was more expensive than that in local storage by Rs.4.51 per quintal.

Storage charges formed the major cost item for storing potato in cold storage accounting for 42.67 per cent, 56.50 per cent and 60.14 per cent of the total cost in the first, second and third MAH, respectively.

**Table 4.31. Cost of storage of potato in kharif season****(Rs per qtl)**

| Item                                                         | Cold storage             |                           |                         | Local storage            |                          |                          |
|--------------------------------------------------------------|--------------------------|---------------------------|-------------------------|--------------------------|--------------------------|--------------------------|
|                                                              | Cost<br>1 MAH            | Cost<br>2 MAH             | Cost<br>3 MAH           | Cost<br>1 MAH            | Cost<br>2 MAH            | Cost<br>3 MAH            |
| Loading and unloading charges at farm and storage unit       | 4.00<br>(5.33)           | --                        | --                      | --                       | --                       | --                       |
| Transportation charges from farm to storage unit             | 4.00<br>(5.33)           | --                        | --                      | --                       | --                       | --                       |
| Losses during handling, storage and transit                  | @5 %<br>22.95<br>(30.61) | @ 7 %<br>32.13<br>(28.37) | @9%<br>41.31<br>(25.88) | @10%<br>45.90<br>(62.92) | @15%<br>68.85<br>(60.40) | @20%<br>91.80<br>(59.18) |
| Transportation charges from storage unit to market           | 3.00<br>(4.00)           | 3.00<br>(2.65)            | 3.00<br>(1.88)          | 5.00<br>(6.85)           | 5.00<br>(4.39)           | 5.00<br>(3.22)           |
| Charges for loading and unloading at storage unit and market | 4.00<br>(5.33)           | 4.00<br>(3.53)            | 4.00<br>(2.51)          | 4.00<br>(5.48)           | 4.00<br>(3.51)           | 4.00<br>(2.58)           |
| Storage charges                                              | 32.00<br>(42.67)         | 64.00<br>(56.50)          | 96.00<br>(60.14)        | 13.00<br>(17.82)         | 26.00<br>(22.81)         | 39.00<br>(25.14)         |
| Interest on working capital                                  | 5.05<br>(6.73)           | 10.14<br>(8.95)           | 15.33<br>(9.60)         | 5.05<br>(6.92)           | 10.14<br>(8.90)          | 15.33<br>(9.88)          |
| <b>Total</b>                                                 | <b>75.00<br/>(100)</b>   | <b>113.27<br/>(100)</b>   | <b>159.64<br/>(100)</b> | <b>72.95<br/>(100)</b>   | <b>113.99<br/>(100)</b>  | <b>155.13<br/>(100)</b>  |

\* MAH = Months After harvest

Figures in parenthesis indicate percentage to the total



However, in the case of local storage structures, the major item of cost involved in storing potato was the losses incurred in storage due to spoilage which accounted for 62.92 per cent, 60.40 per cent and 59.18 per cent in the first, second and third MAH, respectively. From the Table 4.31, it can be seen that there was no substantial difference in the cost incurred in storing potato by farmers in kharif season in local and cold storage structures.

The Table 4.32 shows the cost incurred by farmers for storing rabi potato. The cost of storing per quintal potato in cold storage and local storage units worked out to be Rs.66.52 and Rs.57.52, respectively the first month. Subsequently, in the second and third MAH storing in local storage was cheaper than in cold storage by Rs.10.40 and Rs.19.80, respectively.

Storage charges formed the major cost item in cold storage units accounting for 48.11 per cent, 63.70 per cent and 67.37 per cent of the total cost in the first, second and third MAH, respectively. In the case of local storage structures, the major item of cost involved was the losses incurred in storage due to spoilage which accounted for 55.63 per cent, 53.29 per cent and 52.16 per cent in the first, second and third MAH, respectively.

The net gains by storing potato in cold storage are presented in Table 4.33. The five year average price of rabi and kharif season crops were taken as the base reference price which was Rs.320 and Rs.459

**Table 4.32. Cost of storage of potato in rabi season****(Rs per qtl)**

| Item                                                         | Cold storage              |                           |                         | Local storage            |                          |                          |
|--------------------------------------------------------------|---------------------------|---------------------------|-------------------------|--------------------------|--------------------------|--------------------------|
|                                                              | Cost<br>1 MAH             | Cost<br>2 MAH             | Cost<br>3 MAH           | Cost<br>1 MAH            | Cost<br>2 MAH            | Cost<br>3 MAH            |
| Loading and unloading charges at farm and storage unit       | 4.00<br>(6.01)            | --                        | --                      | --                       | --                       | --                       |
| Transportation charges from farm to storage unit             | 4.00<br>(6.01)            | --                        | --                      | --                       | --                       | --                       |
| Losses during handling, storage and transit                  | @ 5 %<br>16.00<br>(24.05) | @ 7 %<br>22.40<br>(22.30) | @9%<br>28.80<br>(20.21) | @10%<br>32.00<br>(55.63) | @15%<br>48.00<br>(53.29) | @20%<br>64.00<br>(52.16) |
| Transportation charges from storage unit to market           | 3.00<br>(4.51)            | 3.00<br>(2.99)            | 3.00<br>(2.11)          | 5.00<br>(8.69)           | 5.00<br>(5.55)           | 5.00<br>(4.08)           |
| Charges for loading and unloading at storage unit and market | 4.00<br>(6.01)            | 4.00<br>(3.98)            | 4.00<br>(2.81)          | 4.00<br>(6.95)           | 4.00<br>(4.44)           | 4.00<br>(3.26)           |
| Storage charges                                              | 32.00<br>(48.11)          | 64.00<br>(63.70)          | 96.00<br>(67.37)        | 13.00<br>(22.60)         | 26.00<br>(28.87)         | 39.00<br>(31.79)         |
| Interest on working capital                                  | 3.52<br>(5.30)            | 7.07<br>(7.04)            | 10.69<br>(7.50)         | 3.52<br>(6.12)           | 7.07<br>(7.85)           | 10.69<br>(8.71)          |
| <b>Total</b>                                                 | <b>66.52<br/>(100)</b>    | <b>100.47<br/>(100)</b>   | <b>142.49<br/>(100)</b> | <b>57.52<br/>(100)</b>   | <b>90.07<br/>(100)</b>   | <b>122.69<br/>(100)</b>  |

\* MAH = Months After harvest

Figures in parenthesis indicate percentage to the total

respectively. The results indicated that immediately after harvest the price of potato per quintal increased by Rs.61 per quintal from Rs.320 per quintal in March to Rs.381 in April. The prices subsequently increased in the following months and reached Rs.494 per quintal in July, which amounted to a net gain of Rs.174 from the base reference price. However, the price difference between subsequent months showed a decreasing trend falling from a high of Rs.61 per quintal between harvest time and the first MAH to a low of Rs.3 per quintal between June and July. The cost of storage increased from Rs.66.52 per month in April to Rs.173.30 in July. The net gain on storing in cold storage for the first month was negative to the extent of Rs.5.52. The net gain increased sharply in the subsequent two months to reach a peak of Rs.33.31 per quintal in June. The net gain however fell in fourth month after harvest to just Rs.0.70 per quintal.

In the case of Kharif crop, the price showed a decreasing trend, falling from Rs.459 at the time of harvest in October to Rs.330 in February. The negative gains on storing in cold storage increased from Rs.80 one month after harvest to a peak of Rs.315.46 per quintal four months after harvest. Thus it may be seen that it is not advisable for the farmers to go in for storage of kharif crop. They should dispose the commodity immediately after harvest.

**Table 4.33. Net gains from potato stored in cold storages in Karnataka**

| Months<br>(1) | Particulars<br>(2)          | Price<br>(Rs per<br>quintal)<br>(3) | Price<br>difference<br>between the<br>months (4) | Cost of<br>storage<br>(Rs per<br>quintal) # (5) | Net<br>returns<br>to<br>storage<br>@ (6) |
|---------------|-----------------------------|-------------------------------------|--------------------------------------------------|-------------------------------------------------|------------------------------------------|
|               | <b>Rabi crop:</b>           |                                     |                                                  |                                                 |                                          |
| March         | Price at time of<br>harvest | 320                                 | ---                                              | ---                                             | ---                                      |
| April         | Price one MAH               | 381                                 | 61                                               | 66.52                                           |                                          |
|               | Net gain                    | 61                                  |                                                  |                                                 | -5.52                                    |
| May           | Price two MAH               | 440                                 | 59                                               | 102.07                                          |                                          |
|               | Net gain                    | 120                                 |                                                  |                                                 | 17.93                                    |
| June          | Price three MAH             | 491                                 | 51                                               | 137.69                                          |                                          |
|               | Net gain                    | 171                                 |                                                  |                                                 | 33.31                                    |
| July          | Price four MAH              | 494                                 | 3                                                | 173.30                                          |                                          |
|               | Net gain                    | 174                                 |                                                  |                                                 | 0.70                                     |
|               | <b>Kharif crop:</b>         |                                     |                                                  |                                                 |                                          |
| Oct           | Price at time of<br>harvest | 459                                 | ---                                              | ----                                            | ---                                      |
| Nov           | Price one MAH               | 454                                 | -5                                               | 75.00                                           |                                          |
|               | Net gain                    | -5                                  |                                                  |                                                 | -80                                      |
| Dec           | Price two MAH               | 452                                 | -2                                               | 112.09                                          |                                          |
|               | Net gain                    | -7                                  |                                                  |                                                 | -119.09                                  |
| Jan           | Price three MAH             | 378                                 | -74                                              | 149.28                                          |                                          |
|               | Net gain                    | -81                                 |                                                  |                                                 | -230.28                                  |
| Feb           | Price four MAH              | 330                                 | -48                                              | 186.46                                          |                                          |
|               | Net gain                    | -129                                |                                                  |                                                 | -315.46                                  |

**Note:****\*MAH** = Months After Harvest**#** = from Table 4.29 and 4.30. The cost in subsequent months will increase by Rs 32 per month + interest on working capital**@** = Net gain (3) – cost (5)

Market structure analysis involves study of the extent of competition in the market. However, the analysis of one market can be indicative of the structure in other markets. Hence, Chikkaballapur market was analyzed to determine the market structure. The market structure of Chikkaballapur APMC market for potato was analyzed by using the concentration of buyers. The concentration of buying was quantified through the Lorenz curve, and Gini concentration Ratio (GCR). This analysis provides an insight into the structure of the market, i.e., whether the market is competitive or concentrated. For analysis, the entire transactions made by different buyers on 24 randomly selected days during 2001-02 were recorded. The proportion of buyers and their respective shares of potato transacted in value terms were worked out and averaged for 24 days. This analysis has been carried out for the average data. This would help us to know the extent of concentration of trade among the commission agents in Chikkaballapur market.

The concentration of buying, reflected through Gini concentration ratio, was 0.5834. This can also be seen in the Lorenz Curve drawn by plotting the cumulative percentage of market share and against the cumulative percentage of traders depicted in Figure 4.15. It may be observed that the Lorenz curve was away from the egalitarian line.

The results in Table 4.34 show the market concentration in APMC Chikkaballapur. It can be concluded that lowest decile of commission

**Table 4.34. Percentage distribution of buyers handling potato in chikkaballapur market**

| Percentage of buyers | Market share |
|----------------------|--------------|
| 0.1000               | 0.0041       |
| 0.2000               | 0.0162       |
| 0.3000               | 0.0285       |
| 0.4000               | 0.0580       |
| 0.5000               | 0.0855       |
| 0.6000               | 0.1527       |
| 0.7000               | 0.2197       |
| 0.8000               | 0.3792       |
| 0.9000               | 0.5476       |
| 1.0000               | 1.0000       |

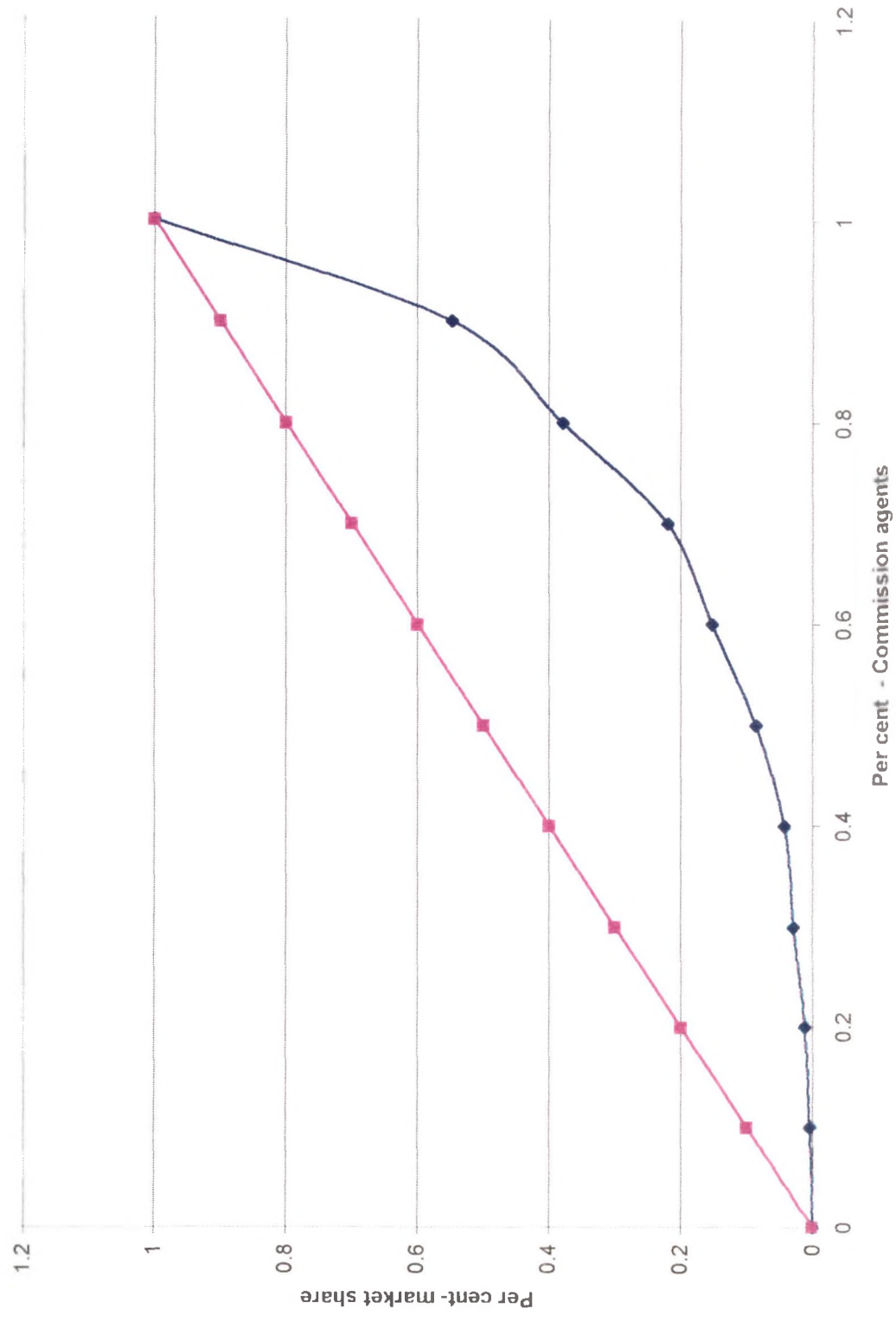


Fig 4.15 Lorenz curve showing concentration of potato traders in chikkaballapur market

agents accounted for 0.4129 per cent market share whereas top 20 commission agents have market share of 45.2334 per cent which denotes a moderate degree of market concentration.

The concentration depicted in the Lorenz curve is captured by a Gini concentration ratio of 0.5834 which reveals a moderately high degree of concentration.

## **4.8 Direction of trade and export competitiveness of potato**

### **4.8.1 Direction of trade and changing pattern of exports**

Markov chain analysis was used to study the direction of trade by estimating the transitional probability matrices. The probability of retaining the previous period market share (gain or loss) is interpreted by studying the diagonal and off diagonal elements of transitional probability matrix. The transitional probabilities matrix for potato exports from India to major importing countries is presented in Table 4.35 which gives a broad indication of the change in the direction of trade of Indian potato. The major importing countries considered for the analysis were Nepal, Sri Lanka, Malaysia, Mauritius, UAE and Singapore while the remaining importing countries were grouped as others.

As evident from the Table 4.35, the probability matrix indicated that Indian potato exports to Nepal could not retain its share. Mauritius gained 23.86 per cent, UAE gained 21.72 per cent and others gained



Table 4.35: Transitional probability matrix of Indian potato exports (1993 to 2000)

|           | Nepal         | UAE           | Sri Lanka     | Mauritius     | Singapore     | Malaysia      | Others        |
|-----------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| Nepal     | <b>0.0000</b> | 0.2172        | 0.0000        | 0.2386        | 0.0000        | 0.0000        | 0.5442        |
| U.A.E     | 0.4306        | <b>0.3451</b> | 0.0000        | 0.0000        | 0.0000        | 0.0647        | 0.1596        |
| Sri Lanka | 0.0000        | 0.0080        | <b>0.9821</b> | 0.0015        | 0.0032        | 0.0000        | 0.0053        |
| Mauritius | 0.0000        | 0.1314        | 0.0188        | <b>0.0141</b> | 0.0390        | 0.0000        | 0.7966        |
| Singapore | 0.0000        | 0.0000        | 0.0000        | 0.0000        | <b>0.0000</b> | 0.0000        | 1.0000        |
| Malaysia  | 0.0000        | 0.0000        | 0.0000        | 1.0000        | 0.0000        | <b>0.0000</b> | 0.0000        |
| Others    | 0.1421        | 0.0466        | 0.6314        | 0.1496        | 0.0146        | 0.0158        | <b>0.0000</b> |

54.42 per cent of Nepal's share. Nepal however gained 43.06 per cent of UAE and 14.21 per cent of others share.

India retained 98.21 per cent of its export to Sri Lanka. Malaysia lost 100 per cent of its share to Mauritius. India could retain only 1.41 per cent of Mauritius share. Mauritius lost 79.66 per cent of its share to others and 13.41 per cent to UAE.

India's export to UAE was retained to the tune of 34.51 per cent while Nepal, Malaysia and others captured 43.06 per cent, 6.47 per cent and 15.96 per cent of India's share of UAE market, respectively. Singapore lost 100 per cent of its share to other countries. In the case of other countries, India could not retain its share to these countries. Others captured 100 per cent of Singapore share, 79.66 per cent of Mauritius share, 54.42 per cent of Nepal share, 15.96 per cent of UAE share.

#### **4.8.2 Projections of Indian potato export to major importing countries**

Using the transitional probability matrix, market share projections of Indian potato exports to major importing countries were worked out up to 2010. Table 4.36 presents the actual and estimated proportions of Indian potato exports to major importing countries. Table 4.37 shows the projected export share of Indian potato exports to different importing countries.

**Table 4.36. Actual and estimated export shares of Indian potato to major importers (percentages)**

| Year | Nepal  |           | UAE    |           | Sri Lanka |           | Mauritius |           | Singapore |           | Malaysia |           | Others |           |
|------|--------|-----------|--------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|-----------|--------|-----------|
|      | Actual | Estimated | Actual | Estimated | Actual    | Estimated | Actual    | Estimated | Actual    | Estimated | Actual   | Estimated | Actual | Estimated |
| 1992 | 34.34  | 23.92     | 50.57  | 25.61     | 0.00      | 9.53      | 3.51      | 10.45     | 0.00      | 0.22      | 0.00     | 3.51      | 15.09  | 26.76     |
| 1993 | 23.92  | 23.92     | 29.38  | 25.61     | 0.00      | 9.53      | 10.45     | 10.45     | 0.16      | 0.22      | 3.51     | 3.51      | 32.57  | 26.76     |
| 1994 | 17.28  | 17.28     | 17.61  | 18.23     | 20.76     | 20.76     | 23.59     | 14.24     | 8.07      | 0.88      | 4.26     | 2.41      | 8.44   | 26.19     |
| 1995 | 8.15   | 8.78      | 13.49  | 13.49     | 26.16     | 26.16     | 10.01     | 10.01     | 1.11      | 1.11      | 0.27     | 1.27      | 40.81  | 39.18     |
| 1996 | 5.97   | 11.61     | 9.85   | 9.85      | 58.08     | 51.65     | 8.50      | 8.50      | 1.07      | 1.07      | 0.72     | 1.52      | 15.81  | 15.81     |
| 1997 | 12.16  | 6.49      | 13.49  | 7.01      | 68.12     | 67.18     | 2.31      | 4.72      | 0.65      | 0.75      | 0.12     | 0.89      | 3.15   | 12.97     |
| 1998 | 3.88   | 6.26      | 8.29   | 8.29      | 68.93     | 68.93     | 5.98      | 3.63      | 0.65      | 0.35      | 0.64     | 0.92      | 11.62  | 11.61     |
| 1999 | 0.62   | 5.22      | 2.49   | 5.58      | 79.49     | 75.15     | 0.12      | 3.49      | 0.54      | 0.62      | 2.27     | 0.72      | 14.47  | 9.22      |
| 2000 | 12.04  | 3.13      | 7.88   | 2.32      | 71.77     | 87.20     | 5.19      | 4.71      | 0.47      | 0.47      | 0.86     | 0.39      | 1.79   | 1.72      |
| Mean | 13.15  | 11.84     | 17.00  | 12.89     | 43.70     | 46.23     | 7.35      | 7.80      | 1.41      | 0.63      | 1.41     | 1.68      | 15.97  | 18.92     |

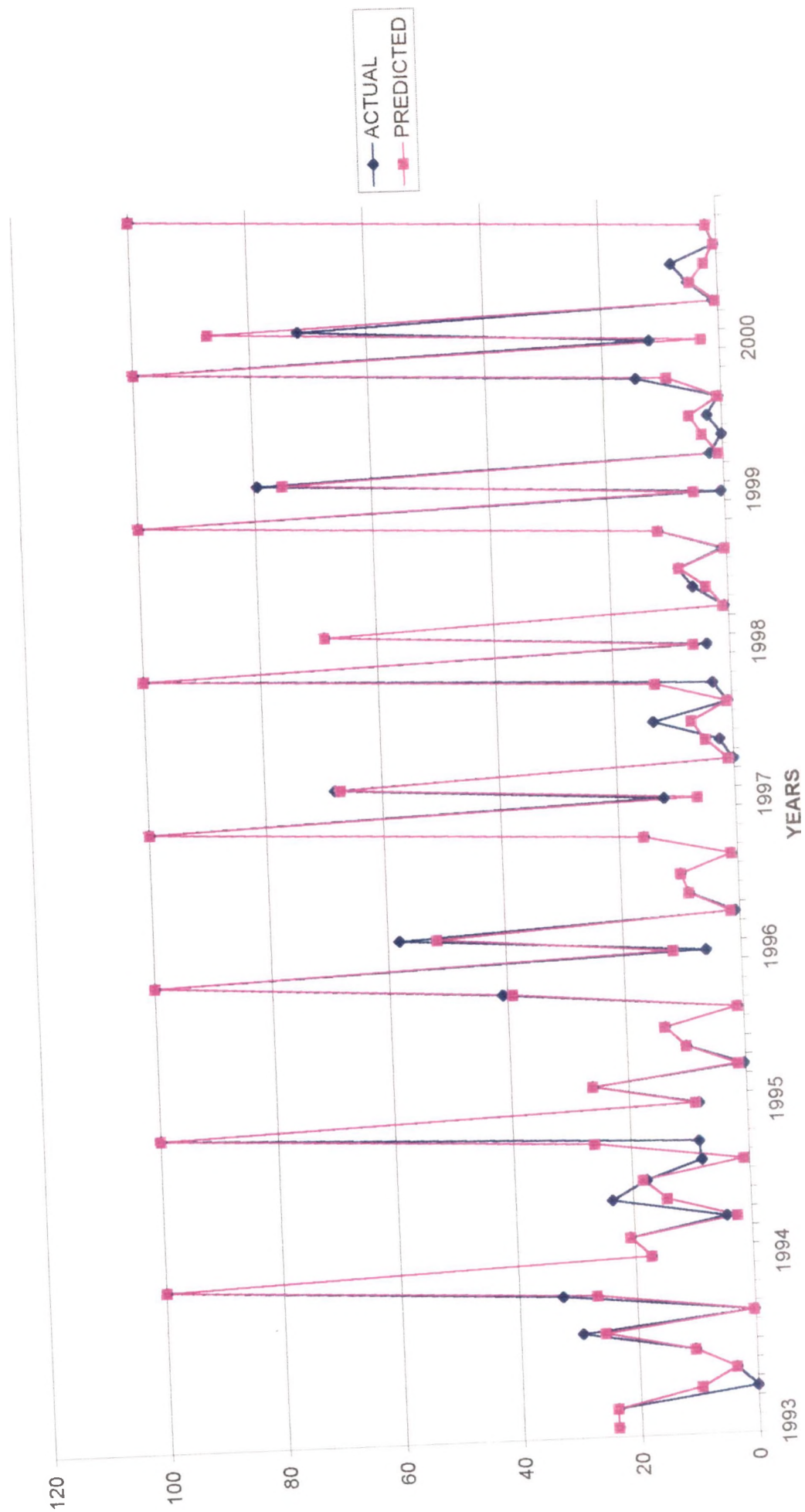


Fig 4.16 Actual and predicted share of potato export from India

Nepal had 34.34 per cent actual share in 1992 which decreased to 12.04 per cent in 2000. The estimate is expected to decrease further from 23.92 per cent to 3.13 per cent for the same period. The projected share for Nepal of India's export by 2010 is 1.42 per cent. (Table 4.36)

The actual, estimated and predicted values for Sri Lanka show an increasing trend. The estimated projection for Sri Lanka by 2010 is 91.55 per cent. In the case of Malaysia, the actual, estimated and predicted values show a decreasing trend from 4.26 per cent in 1994 to 0.86 per cent in 2000. It is further projected to decrease to 0.20 per cent by 2010. Mauritius also showed a declining trend from 4.19 per cent in 2001 to 2.05 percent and 1.21 per cent, respectively by 2005 and 2010.

The actual proportion of potato exports from India to UAE decreased from 50.57 per cent in 1992 to 7.88 per cent in 2000. The estimated value also declined from 25.61 per cent in 1992 to 2.32 per cent. The projected export share for UAE by 2010 is 2.15 per cent. In case of Singapore, the actual value reached an all time high of 8.07 per cent in 1994 and subsequently decreased to 0.47 per cent in 2000. The projected share for the year 2001, 2005 and 2010 are 0.46 per cent, 0.45 per cent and 0.39 per cent, respectively. In the case of other countries the export share to these countries are predicted to fall from 12.79 per cent in 2001 to 4.90 in 2005 and subsequently to 3.08 per cent by 2010.

Table 4.37. Projected export share of Indian potato to major importing countries (percentages)

| Year | Nepal | UAE  | Sri Lanka | Mauritius | Singapore | Malaysia | Others |
|------|-------|------|-----------|-----------|-----------|----------|--------|
| 2001 | 3.65  | 6.67 | 71.71     | 4.19      | 0.46      | 0.54     | 12.79  |
| 2005 | 2.30  | 3.05 | 86.95     | 2.05      | 0.45      | 0.31     | 4.90   |
| 2010 | 1.42  | 2.15 | 91.55     | 1.21      | 0.39      | 0.20     | 3.08   |

Export Competitiveness indicates the ability of a firm to produce commodities with certain level of efficiency, so that they can compete in the international market. Competitiveness is a dynamic process which needs to be created and sustained. In this study two quantitative measures of export competitiveness, viz, (I) Nominal Protection coefficient (NPC) and (II) Domestic Resource Cost (DRC) have been used.

**a) Nominal Protection Coefficient (NPC)**

The NPC is the ratio of domestic price to the world reference price adjusted for transfer costs. Commodities with NPC more than one are protected, while commodities with ratio less than one are dis protected by the policy regime, relative to the situation that would prevail under free trade.

Domestic price is normally the wholesale market price of the commodity in the selected market. The reference price is the international price adjusted for transfer costs, marketing and trading margins including the processing charges necessary to make the commodity equivalent to the internationally traded commodity. NPC could be estimated under two distinct Hypotheses, (i) The importable hypothesis and the (ii) Exportable hypothesis. The reference price estimation method is given in Table 4.38 and 4.39.

It could be seen from the Table 4.38, that the NPC for potato was highest during 1999 – 2000 at 1.590 and least during 2000 – 2001 at

**Table 4.38. Nominal protection coefficient of Indian potato (Exportable hypothesis)**

| Sl. No. | Particulars                                  | Place     | Unit    | 1999-2000 | 2000-2001 | 2001-2002 | Overall |
|---------|----------------------------------------------|-----------|---------|-----------|-----------|-----------|---------|
| 1.      | Wholesale price of potato                    | Bangalore | Rs/Qtl  | 482.500   | 509.000   | 544.700   |         |
| 2.      | Plus packing, handling and transport cost to | Chennai   | Rs/Qtl  | 148.100   | 173.500   | 191.000   |         |
| 3.      | Plus marketing margin (5%)                   |           | Rs/Qtl  | 24.125    | 25.450    | 27.240    |         |
| 4.      | Equals FOB price                             | Chennai   | Rs/Qtl  | 654.725   | 707.95    | 762.940   |         |
| 5.      | Plus freight charge                          |           | Rs/Qtl  | 320.73    | 345.807   | 377.360   |         |
| 6.      | Plus insurance at 1%                         |           | Rs/Qtl  | 6.551     | 7.079     | 7.629     |         |
| 7.      | Equals landed price                          | U.K       | Rs/Qtl  | 981.995   | 1060.837  | 1147.929  |         |
| 8.      | Exchange rate                                |           | 1\$= Rs | 43.050    | 44.910    | 47.170    |         |
| 9.      | Equals landed cost (CIF price)               |           | \$/Qtl  | 22.170    | 23.421    | 24.336    |         |
| 10.     | Reference price                              | U.K       | \$/Qtl  | 14.348    | 21.974    | 16.021    |         |
| 11.     | NPC of potato (Row 9 /Row 10)                |           |         | 1.590     | 1.075     | 1.519     | 1.395   |

Note: FOB - Free on board

CIF - Cost insurance and freight



Table 4.39. Nominal protection coefficient of Indian potato (Importable hypothesis)

| Sl. No. | Particulars                                 | Place     | Unit    | 1999-2000 | 2000-2001 | 2001-2002 | Overall |
|---------|---------------------------------------------|-----------|---------|-----------|-----------|-----------|---------|
| 1.      | FOB price                                   | U.K       | \$/Qtl  | 14.348    | 21.974    | 16.021    |         |
| 2.      | Plus freight charge                         |           | \$/Qtl  | 7.450     | 7.700     | 8.000     |         |
| 3.      | Plus insurance at 1%                        |           | \$/Qtl  | 1.435     | 2.197     | 1.602     |         |
| 4.      | Equals CIF price                            |           | \$/Qtl  | 23.233    | 31.871    | 25.623    |         |
| 5.      | Exchange rate                               |           | 1\$= Rs | 43.050    | 44.910    | 47.170    |         |
| 6.      | Equals landed price                         | Chennai   | Rs/Qtl  | 1000.180  | 1431.346  | 1208.633  |         |
| 7.      | Plus handling and transport cost to         | Bangalore | Rs/Qtl  | 120.000   | 146.000   | 165.000   |         |
| 8.      | Equals landed price                         | Bangalore | Rs/Qtl  | 1120.180  | 1577.346  | 1373.633  |         |
| 9.      | Wholesale price of potato (Reference price) | Bangalore | Rs /Qtl | 482.500   | 509.000   | 544.700   |         |
| 10.     | NPC of potato (Row 9/Row 8)                 |           |         | 0.431     | 0.323     | 0.397     | 0.383   |

Note: FOB - Free on board

CIF - Cost insurance and freight

1.075 under exportable hypotheses. The average NPC for the period 1999 – 2002 was 1.395, which indicates a high level of protection coefficient.

The NPC under importable hypotheses is presented in Table 4.39. The NPC value ranged from a peak of 0.431 during 1999 – 2000 to a low of 0.323 in 2000 – 2001. The average NPC value of 0.383 imply that domestic prices received by farmers were below the international prices and potato cultivators in the study region were dis protected to some extent or in effect taxed on the pricing front compared to the free trade situation.

#### **b) Domestic Resource Cost**

The Domestic Resource Cost (DRC) is defined as the value of domestic resource it takes to save or earn a unit of foreign' exchange through the production or export of the commodity. It is estimated as a ratio of the proportion of non-traded (non-tradable) inputs to the value added by the proportion of traded inputs in the production of that commodity.

The most crucial issue in the estimation of this measure of export competitiveness is the identification of resources as traded or non traded. Normally, the non-traded resources are those which are not traded internationally. These include resources such as human labour and farm yard manure. The resources which are considered under the traded category are fertilisers, pesticides, seed and capital. The traded resources have an international reference. In estimating the domestic resource cost,

**Table 4.40. Domestic resource cost ratio of potato**

| Sl no.     | Particulars                                      | Value (in Rs) |
|------------|--------------------------------------------------|---------------|
|            | Marginal value of non traded inputs              |               |
| 1.         | Human labour                                     | 1049.84       |
| 2.         | Farm yard manures                                | 852.46        |
| <b>(A)</b> | Total non tradable inputs                        | 1902.30       |
|            | Marginal value of tradable inputs                |               |
| 1.         | Seeds                                            | 301.85        |
| 2.         | Fertiliser                                       | 257.36        |
| 3.         | Plant protection chemicals                       | 151.42        |
| <b>(B)</b> | Total tradable inputs                            | 710.63        |
| <b>(C)</b> | International reference price (\$ /tonne)        | 160.21        |
| <b>(D)</b> | Exchange rate (1 \$ = Rs )                       | 48.85         |
|            | Domestic Resource Cost ratio $\{A/[(C*D) - B]\}$ | 0.27          |

all the non traded inputs are valued at margin, in order to include all the costs and sacrifices made in order to produce one unit of exported commodity. Thus, the marginal value product or the shadow price or the social cost is used in valuating the non-traded resource. In the case of traded resources, the valuation is at the reference price, in order to be sure that value addition is large enough for the commodity to be competitive.

Thus the DRC has been estimated by working out the marginal value product for non-tradable inputs such as farm yard manure and human labour. In the case of the tradable inputs like fertilizers, pesticides and seed, they were valued at the world reference price. The marginal value product of the non tradable inputs used in the production of one unit of out put is the numerator, while the value of tradable inputs (valued at world prices) subtracted from the price of output per unit (World reference price adjusted to transfer costs) is the denominator. The ratio thus calculated is the Domestic Resource Cost (DRC) and is presented in Table 4.40.

The marginal value of non tradable inputs like human labour and farmyard manure was Rs.1902.30 while total of tradable inputs like seeds, plant protection chemicals and fertiliser accounted to Rs.710.63. The DRC ratio worked out to be less than unity (0.27), indicating high export competitiveness of potato.

Agricultural commodities are characterized by bulkiness, seasonality and perishability. Hence agriculture products are required to be consumed much quicker than industrialized products. Transportation cost forms a major cost component of agricultural produce, hence an optimal transportation model is the need of the hour. An optimal model should necessarily be able to allocate the required amount of produce in the different markets from the total available supply with a view of cost minimization or profit maximization. In this study both cost minimization and profit maximization was carried out using linear programming technique. The constraint imposed on the model was the maximum quantity consumed by each market during the last year (2001) along with the maximum production in the respective districts. The top potato consuming districts are Bangalore, Belgaum, Hassan, Hubli and Kolar markets with a consumption of 20.79 lakh quintals, 5.16 lakh quintals, 3.95 lakh quintals, 2.35 lakh quintals and 1.27 lakh quintals, respectively.

**4.9.1 Cost minimization transportation model**

In this model, the coefficients used in the objective function were obtained by using the minimum cost of transportation of one quintal from one market to another. The results obtained are presented in Table 4.41.

Table 4.41. Cost minimisation transportation model

(Objective function value: Rs 4.01 crores)

|           | Bangalore<br>Market<br>(Qtl) | Belgaum<br>Market<br>(Qtl) | Hassan<br>Market<br>(Qtl) | Hubli<br>Market<br>(Qtl) | Kolar<br>Market<br>(Qtl) |
|-----------|------------------------------|----------------------------|---------------------------|--------------------------|--------------------------|
| Bangalore | 772970.00                    | 0.00                       | 0.00                      | 0.00                     | 0.00                     |
| Belgaum   | 0.00                         | 515729.00                  | 0.00                      | 0.00                     | 0.00                     |
| Hassan    | 0.00                         | 0.00                       | 395109.00                 | 0.00                     | 0.00                     |
| Hubli     | 0.00                         | 0.00                       | 0.00                      | 235268.99                | 0.00                     |
| Kolar     | 1306775.98                   | 0.00                       | 0.00                      | 0.00                     | 127838.00                |

The model suggest that the minimum quantity demanded in each market will be fulfilled respectively except in case of Kolar market which was able to supply Bangalore market its deficit production of 1.31 lakh quintals. The minimum cost the farming community would have to incur in order to follow this model is Rs.4.01 crores. This model however reveals that there is excess supply in all districts except Bangalore which faces deficit production of 1.31 lakh quintals.

#### **4.9.2 Profit maximization transportation model**

This model was constructed to find the most profitable market for selling potato by a farmer, in order to maximize his returns. The coefficients in the objective function were obtained by deducting the cost of transportation and cost of cultivation at the point of production from the average market price prevailing at the point of consumption. The coefficients thus obtained indicate the maximum profit attainable by a farmer. The results obtained using the above coefficients in the model are presented in Table 4.42.

The Table 4.42, indicates that except farmers of Kolar and Hubli all other farmers in the remaining districts should necessarily market their produce in their respective markets for maximizing their profits. The model reveals that the farmers in Kolar and Hubli can market their produce in Bangalore and Belgaum markets, respectively. Farmers of Kolar district can supply to Bangalore market to 13.07 lakh quintal of potato while farmers of Hubli district can supply to Belgaum market to 3 lakh quintals after meeting their own market demands. This model indicated a maximum profit of Rs.42.81 crores attainable by the farmers.

Table 4.42. Profit maximisation transportation model

(Objective function value: Rs 42.81 crores)

|           | Bangalore<br>Market<br>(Qtl) | Belgaum<br>Market<br>(Qtl) | Hassan<br>Market<br>(Qtl) | Hubli<br>Market<br>(Qtl) | Kolar<br>Market<br>(Qtl) |
|-----------|------------------------------|----------------------------|---------------------------|--------------------------|--------------------------|
| Bangalore | 772970.00                    | 0.00                       | 0.00                      | 0.00                     | 0.00                     |
| Belgaum   | 0.00                         | 215478.00                  | 0.00                      | 0.00                     | 0.00                     |
| Hassan    | 0.00                         | 0.00                       | 395109.00                 | 0.00                     | 0.00                     |
| Hubli     | 0.00                         | 300251.00                  | 0.00                      | 235268.99                | 0.00                     |
| Kolar     | 1306775.00                   | 0.00                       | 0.00                      | 0.00                     | 127838.00                |



## *Discussion*

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## V. DISCUSSION

The findings of the study which were presented in the previous chapter are discussed in this chapter under the following major headings to arrive at a meaningful interpretation of the findings.

- 5.1 Trends in arrivals and prices of potato in major markets of Karnataka.
- 5.2 Seasonal pattern of market arrivals and prices of potato.
- 5.3 Market integration among major markets for potato.
- 5.4 Constraints and potentials in the production of potato and feasibility of production of uniform grades and quality of potato.
- 5.5 Gaps in the level of infrastructure facilities like storage, processing, transportation and marketing finance.
- 5.6 Constraints in the full exploitation of the capacities of the existing infrastructural facilities and feasibilities of absorption of increased production of potato.
- 5.7 Market structure in marketing of potato.
- 5.8 Export potentials of potato.
- 5.9 Logistics model for efficient marketing of potato.

## 5.10 Policy measures for management of production and prices of potato in Karnataka.

### **5.1 Trends in arrivals and prices of potato in selected markets of Karnataka**

#### **5.1.1 Trends in arrivals of potato**

The analysis of trend in arrivals of potato presented in Table 4.1 indicated a positive trend in all the markets under study. The arrivals have increased in all the markets, but the quantum of increase in arrivals varied from market to market. The highest annual increase in potato arrivals was noticed in Kolar market which may be because of the increased potato production in Kolar. All the other markets showed positive and significant growth in arrivals except Hubli market indicating the increased arrivals of total potato production of the state into the regulated market for sale. The increased arrivals are due to increase in area under potato in the state coupled with the use of high yielding varieties of potato by farmers. The insignificant growth in arrivals of potato in Hubli market may be due to the increased transport of potato for sale to other markets. The increased arrivals in all the markets clearly showed that farmers are slowly and gradually developing a positive attitude towards the benefits of the regulated markets and thus they are diverting their produce towards the regulated markets from the unregulated markets.

### **5.1.2 Trends in prices of potato**

The trends in prices of potato in Karnataka was analysed for a period of 11 years from 1990- 2001 and the results presented in Table 4.2. It could be seen from Table 4.2, that the prices of potato showed increasing trend in all the selected markets which may be due to the increasing population, which in turn increases the demand for potato coupled with inflationary trend in prices of agricultural commodities.

### **5.1.3 Trends in area, production and productivity of potato in Karnataka**

The area and production of potato in Karnataka showed an increasing trend, which may be because of shift in area under other crops to potato and the use of high yielding varieties by farmers in the study area. Singh *et al.* (1993) reported the change in production of potato in Jalandhar due to the introduction of new technology and change in demand for potato as a result of general economic development. The decreasing productivity however, may be due to non adoption of appropriate scientific potato production practices. Hence there is a need on the part of the extension agencies to impart training to farmers on the right quantity of inputs use to achieve a sustainable potato production in the state.

## **5.2 Pattern of arrivals and prices of potato**

### **5.2.1 Seasonal pattern in arrivals of potato**

Table 4.4, clearly explains the seasonality of market arrivals which is a peculiar feature of any agricultural commodity, where the market arrivals are concentrated in particular months. This is mainly because the farmers rushed their produce immediately after harvest for sale.

The results from Table 4.4 revealed that seasonality in arrivals existed in all the selected markets. In Bangalore market the arrivals reached a peak during the months from October to December on account of arrivals of kharif season crop from Hubli and Belgaum district while the increase in May is mainly due to the rabi season potato crop from Kolar and Chikkaballapur. In Belgaum market the peak arrivals was found in December corresponding to the arrivals from harvest of kharif crop while the second peak in June is due to arrivals of early kharif crop from Hassan and arrivals of seed tubers from Jalandhar for kharif season. The peak arrivals noticed during March in case of Chikkaballapur and Kolar markets correspond to the arrivals from rabi season crop. Belgaum and Hubli markets witnessed maximum arrivals during December and January, respectively which may be due to arrivals from late kharif crop compounded with the arrivals of potato crop from other parts of the country like Jalandhar, Agra and neighbouring markets of Maharashtra. Hassan market showed peaked arrivals during July and August corresponding to arrivals from its early kharif crop. The

indices clearly state that potato farmers rushed their produce for sale immediately after harvest without adopting storage practices. George and Govindan (1975) and Jain and Kaul (1980) reported similar findings on seasonality of potato arrivals.

### **5.2.2 Seasonal pattern in prices of potato**

The pattern of market prices for potato presented in Table 4.5 revealed relatively wide differences among the selected markets. In Bangalore market the price index was higher in August and September which corresponded to low arrivals of potato due to non availability of fresh potato crop in the Karnataka. The prices were relatively higher in the months of January and February on account of lower arrivals of potato from kharif season crop from within the state and other potato growing regions of the country. The prices during July were high indicating receipt of good price for potato crop arrivals from Hassan. The quality of potato from Hassan district fetched higher prices. In Belgaum market the highest prices were received during September which corresponded to the low arrivals of potato due to lack of fresh potato crop. The lowest price in Belgaum market was noticed during May which may be due to participation of only a few traders during this month.

The peak prices during June and July in Chikkaballapur market is due to lack of fresh potato crop from this region. It peaked in December on account of demand for potato seed tuber for rabi season crop. In Hassan market higher indices were found from June to September which

indicated that the early kharif potato crop from Hassan received high prices as there were no potato arrivals from the rest of the state nor from neighbouring states during that period. The price indices were high during July to October which corresponded to the low market arrivals of potato due to lack of potato production during that period. The subsequent fall in price observed from November to March in Hubli market is due to the arrival of kharif season crop starting from October. The high price indices during October to December in case of Kolar market is due lack of arrivals of potato crop during this period and also due to the demand for seed tuber for planting in rabi season. The second price peak observed from June to August is due to lack of fresh potato crop from this region during this period. This clearly indicated that the prices of potato were mainly influenced by their arrivals in these markets in accordance with the law of demand and supply. It could be seen that prices decreased immediately in the post harvest period. Similar results were observed by Singh *et al.* (1993), Keith *et al.* (1997) and Mipramavar and Gummagolmath (1998).

### 5.2.3 Cyclical variations in arrivals and prices of potato in Karnataka

From the figures 4.7 to 4.14, it could be observed that there existed no cycle in any of the selected potato markets in Karnataka. This is mainly because cycle can be observed only if a time series data for 20 years and above are analysed. As the current study was restricted for analysis using only the past 11 year's data (1990-2001), cycle were not observed in any of the markets.

### 5.3 Market integration

Efficient functioning of markets provides remunerative prices for the produce to the farmer-sellers as well provides goods at reasonable prices to the innumerable consumers. One of the common indicators of an efficient functioning of the markets is the existence of high degree of integration among them. In an integrated market, price of a commodity is responsive to price changes of the same quality products in other markets. As such price differences for a particular variety of product in the different markets of the area as a rule should not exceed the cost involved in transportation and handling of the produce. The analysis of price movements for a variety of the commodity in the corresponding and linked markets helps in judging of the extent of efficiency of the marketing system in the region for the selected crop.

An attempt was made to study the extent of market price integration between the selected APMC markets of Karnataka for potato. The simple correlation coefficient technique was made use of to evaluate the integration between the selected market prices.

The results revealed high integration among all the selected markets. The highest integration of 0.904 between Belgaum and Hubli may be because of good communication facilities available coupled with spatial proximity between these markets (90 km). Balappa shivaraya (2000) also observed high degree of integration between Belgaum and Hubli markets for potato. Hassan was least correlated with all the markets



probably because most of its production makes its way into other state markets. This is mainly because Hassan potato is of superior quality and the time of its harvest coincides with non crop season in the major potato growing states of North India.

Bangalore market was highly integrated with Belgaum market which in turn is influenced by Mumbai. Belgaum acted as proxy for Mumbai and Maharashtra state as a whole and as such any instability created at Belgaum is reflected at Bangalore. Similar findings were found by Girish (1995). Kolar and Chikkaballapur markets were least integrated with Hassan as they are all excess potato producing districts and as such the produce from these districts were usually not marketed among these markets. Kolar and Chikkaballapur markets were well integrated with Bangalore market as it was the terminal market for potato from these regions. This clearly indicated that the prices of potato were governed not only based on the arrivals and other factors in the given market but also those prevailing in the other markets. This might be due to the movement of produce from one market to another depending on the price prevailing in the markets. It could be concluded that the potato markets in Karnataka are well integrated with one another due to availability of good communication facilities and associated transportation infrastructure like rail and road lines to markets. Behura and Pradhan (1998) and Olani Wirtu Wakjra (1999) also concluded that good communication facilities and better infrastructure result in highly integrated markets. The current system of market

information dissemination to farmers through commission agents should be further enhanced by creating a special cell at APMCs to generate market information and market intelligence which would provide a better platform for guiding the farmers in marketing their produce.

#### **5.4 Constraints and potentials in the production of potato and feasibility of production of uniform grades and quality of potato**

The results of the primary survey undertaken to study the constraints in production of uniform grades of potato revealed that unawareness and non availability of Package of Practice (POP) books was considerably high in all the selected districts. Hence efforts need to be made to popularize the usage of Package of Practice for scientific farming of potato, which would help in increasing the productivity of potato in the state. Farmers were satisfied with the timely availability and quality of potato seeds indicating that the seeds procured by traders from Jalandhar were available to the farmers at the right time and sufficient quantity for planting of the new potato crop.

The survey was also undertaken for observing reasons for non production of uniform size of produce. The farmers opined that the absorption of all the nutrients by the first tuber formed on the plant and non uniform soil fertility were the major contributors for the same. Non uniform fertiliser application and non uniform irrigation were also quoted by farmers for non uniform size of produce. However, the scientists' view that genetic nature of the plant is what causes non uniform produce was

unknown to the farming community. Soil type also influences the non uniform tuber formation to some extent. Black soil type are suited for potato cultivation, however the soil type most suited for potato cultivation are the sandy loam type which is found in Kolar and Hassan potato growing regions. Hence there is a need to educate the farmers on this aspect which could help farmers refrain from excessive use of fertilizer application and this will substantially result in lower cost of cultivation. Balappa shivarya (2000) also observed that the lack of technical knowledge for adoption of improved varieties was the major constraint in vegetable cultivation in North Karnataka.

## **5.5 Gaps in the level of infrastructure facilities like storage, processing, transportation and marketing finance**

### **5.5.1 Availability of infrastructure facilities at selected APMCs**

Infrastructure plays an important role in the marketing of potato in the state. The study was undertaken to find out the adequacy of existing infrastructure in the selected APMCs. Due to well developed transportation network services in all the selected markets, transport infrastructure was not at all a problem faced by farmers. This is also because farmers preferred to transport potato to their local market using tractor. The major infrastructure lacunae in APMCs were the absence of temporary storage facilities according to majority of the farmers except in Hubli market, which had adequate space mainly because of its large market area. The lack of such facilities in markets forces farmers to

dump their produce irrespective of the price as they are not in a position to carry their produce back to their field. The reason quoted for absence of such temporary storage facility according to traders is that once the transaction is carried out the produce is immediately transported from the market yard. This resulted in lack of adequate temporary storage facility with the traders. Hence temporary storage facility must be made available at the market yard. This would enable farmers to store their produce for a few days at the market at a nominal charge. Nagaraj *et al.* (1985) in their study on market appraisal of fruits and vegetables documented that the commission agents and retailers complained about congestion in market yard, which made it difficult to transact the heavy market arrivals. They suggested better infrastructure facilities ranging from scientific storage to transportation and processing. Lack of grading and physical facilities in all the markets was another major lacuna. Hence steps need to be taken to provide such facilities in all the marketing yards which would facilitate scientific grading of commodities in the market and as such result in farmers receiving better prices. Though on paper, grades are available in the market yards, it is generally found that neither the farmers nor the graders grade the produce. It is important to educate the farmers on importance of scientific grading before sale which would benefit both the farmers and the consumers. Narappanavar and Bavur (1998) also reported the lack of grading facilities in their study on potato marketing in Dharwad.

### **5.5.2 Farmers opinion on transaction facilities at selected APMCs**

The transaction facilities availed by farmers at APMC yard include bidding, weighing, payment of commission charges, deduction of market fees and payment of cash for produce. In all the selected markets, farmers were satisfied with the transaction facilities, although a small percentage of them reported faulty system of weighing, unreasonable commission charges and prolonged payment of cash for produce. Hence there is a need on the part of the APMC staff and management to initiate steps to curb such malpractices. Similar findings were reported by Narappanavar and Bavur (1998) on potato marketing system in Dharwad district.

### **5.5.3 Marketing of potato by farmers**

Potato marketing in Karnataka is mainly undertaken by commission agents in APMCs. A primary survey was undertaken to determine the reasons why farmers sold through particular commission agents. The results revealed that immediate cash payments, better prices received, small quantity of produce, low marketing costs and reception of information on market situation were the main reasons. The commission agents were able to disseminate market situation prevailing in different markets to farmers mainly due to advancement of communication facilities. The commission agents provided information services to farmers which were undertaken as a part of their business. However none of the farmers had previous agreements with the commission

agents as they preferred to sell their produce to commission agents who quoted the highest prices in the market. A few farmers who had social ties with intermediary were getting advance loan for production, in addition to storage and transportation facilities. Lack of storage facility at commission agents' level necessitates the need for creation of temporary storage facilities at market yards which could be used by farmers during the period of glut or conditions of low price.

## **5.6 Constraints in utilisation of existing infrastructure**

Potato being a perishable product requires ambient conditions for storage for long duration. Potatoes are stored in cold storages and on farm local storage structures. In Karnataka there are 53 cold storages storing horticulture commodities including potato. It could be seen from Table 4.12, that majority of the cold storages operational in Karnataka were located in Bangalore which may be due to the fact that it is a terminal market. Hassan had three cold storage mainly storing potato but it however accounted for only 4.2 per cent of the total storage capacity in the state.

Table 4.13, shows that majority of the sampled farmers adopted local storage structure as means for storing which might be due to the high cost of cold storage, lower flexibility in marketing of produce and fixed cost associated for storing potato in cold storages. Kainth (1989) also quoted weak financial position of farmers and price uncertainty as constraints in storing potatoes in cold storage by farmers in Punjab. The

average quantity stored per farmer in local storage structures was higher in large size group of farmers (138 quintals per farmer) compared to small farmers who stored 75 quintals, which might be due to the large quantity of production and higher retention capacity of large farmers compared to small farmers. Chatha and Sidhu (1980) reported that only 32.5 per cent of farmers took advantage of cold storage facilities, of which 82 per cent of them were large farmers.

The farmers' behaviour in storing potato presented in Table 4.14 revealed that majority of the farmers' stored potato in local storage structure except in Hassan where an equal percent of farmers stored in cold and local storage structures. This is because the local storage structures are made out of locally available materials on the farm which involves minimum cost. Heaping potatoes beside their place of vocation or threshing yard is quite common among the farmers. Higher percentage of farmers are storing potato in cold storage in Hassan due availability of operational cold storages dedicated for potato storage as seen from Table 4.12. Though there are a number of cold storage structures in other districts they are not operational for want of adequate maintenance or they are not exclusively potato storage houses. In Hassan the percentage of farmer not storing potato was the least in the state as farmers felt they receive higher price for their produce on storing potato. In other districts the percentage of farmers not storing potato was much higher which may be because of lack of interest on the part of the farmers to storage

function as they felt the price differentials are not encouraging to store the produce and also due to their low retention power.

### **5.6.1 Cost of construction of storage structures**

The cost of constructing local storage structure worked out to Rs.4100 as seen from Table 4.15. The major item of cost was incurred on tarpaulin which is used for covering the potato under storage during rains; hence it was an unavoidable expenditure to the farmers. Bamboo was used for constructing the supporting frames of local structure as it was much cheaper source than concrete structures. The labour cost was incurred only during construction period.

The major item of cost incurred in construction of a cold storage was in building and refrigeration plant which accounted for nearly 76.10 per cent of the total cost of establishment followed by cost of electrification and diesel generator as these were the major components in construction of a cold storage unit (Table 4.16).

The cost and returns in different storage structures for owners shown in Table 4.17 indicated the cost and returns in the local (Heap) and cold storage structures. The net return was calculated based on the assumption that local storage structure would be let out for hiring at the rate of Rs.16 per quintal per month. The net return so obtained was Rs.730. This indicated that there exists scope for setting up local storage structures on a collective basis in villages on an experimental basis and as such reap the benefits of economy of scale. Similarly the cost and



returns in cold storage structure of 25,000 quintals capacity was calculated. The net return was found to be Rs.6,18,986.36 per year, which indicated the profitable nature in investing in cold storages in the study area.

The major item of cost for local and cold storage structures as observed from Table 4.18 indicate that watch and ward charges was the only establishment charge incurred in local storage structure. In the case of cold storage, the cost incurred was different during peak and lean seasons to the extent of electricity charges. The electricity charges incurred during lean season is towards the payment of minimum charges to electricity board. The maintenance cost is same for lean and peak season, which is due to the fact that the refrigeration unit must be run even during lean season. The insurance and establishment remain the same during both the periods as they are components of fixed cost in cold storage unit.

## **5.6.2 Financial feasibility of investing in storage structures**

### **5.6.2.1 Financial feasibility of investing in cold storage structure**

The cash flow statement for cold storages running under different levels of capacity utilisation revealed that the cash outflow was varying for the first 10 years mainly due to the repayment of loans. The net cash flow and the discounted net cash flow were positive at all levels of capacity utilisation viz., 42, 50, 60 and 70 per cent (Table 4.19, 4.20, 4.21 and 4.22) indicating the profitability of investing in cold storages.

The increasing income was mainly due to higher returns obtained by cold storages on increasing capacity utilisation. As the capacity utilisation increased the fixed cost get spread over larger units under storage and as such decreases the cost of operation.

#### **5.6.2.2 Evaluation of investment in cold storage structure**

The financial feasibility of investing in local and cold storage structures was determined by using the standard financial techniques like NPV, BCR, IRR and Pay Back Period analysis and results are presented in Table 4.23.

##### **a) Net present Value (NPV)**

It can be seen from Table 4.23, that the NPV was Rs.9.17 lakhs at 42 per cent, Rs.69.25 lakhs at 50 per cent, Rs.1.29 crores at 60 per cent and Rs.1.89 crores at 70 per cent capacity utilization. It could be observed that Net Present Value was greater at higher capacity utilisation than at lower capacity utilisation. This is due to increasing returns and greater economy of scale.

##### **b) Benefit Cost Ratio (BCR)**

The BCR was 1.05 at 42 per cent capacity utilisation which subsequently increased to 1.39, 1.73 and 2.08 at 50 per cent, 60 per cent and 70 per cent capacity utilization, respectively. The results showed that running cold storages at higher capacity utilisation was more profitable than running under lower capacity utilisation. However, since at all levels

of capacity utilisation the BCR was greater than unity, it could be concluded that the investment in cold storage units is financially feasible and economically viable.

**c) Internal rate of Return (IRR)**

The internal rate of return indicates the rate of returns that can be earned by reinvestment. The IRR at 42 per cent capacity utilisation (10.68 per cent) was less than the current interest rate of 13.5 per cent indicating that it was unviable to run the cold storage at 42 per cent capacity utilisation. However IRR increased from 15.85 per cent at 50 per cent to 25.67 per cent at 70 capacity utilisation, indicating higher rate of returns on increasing capacity utilisation.

**d) Pay Back Period (PBP)**

The Pay Back Period for 42 per cent capacity utilisation was 8.9 years which reduced to 4.6 years on increasing the capacity utilisation to 70 per cent, indicating lower pay back period on increased capacity utilisation. This is because of increasing returns at higher capacity utilisation coupled with the benefits of economy of scale.

Thus, all the criteria of project evaluation indicated that it was financially feasible for investing in cold storages in Karnataka. The inference drawn based on the several criteria for evaluation of investment revealed the results are in conformity with the general belief that higher level capacity utilisation is more profitable than lower level capacity utilisation. This is obvious due to economy of scale. Higher capacity

utilisation is possible by constructing cold storages for multi-commodity storage function, which would reduce the dependence on a single commodity and help in tiding over periods of deficit production of potato due to natural calamities and also during lean season for potato.

#### **5.6.2.3 Financial feasibility of investing in local storage structure**

The local storage structure was evaluated on the basis of returns earned at the end of storage period. From the Table 4.24, it could be observed that the kharif season showed a decreasing trend in prices from harvest, falling from Rs.459 per quintal at harvest to Rs.378 per quintal at the end of three months of storage. It could be concluded that potato should be immediately sold on harvest during kharif season. This might be due to the fact that majority of the potato is harvested during kharif season in Karnataka which results in large quantity arrivals during the period causing the prices to fall. Thus kharif season farmers should sell their produce immediately after harvest. It is also necessary to examine whether the potato cultivation can be shifted from kharif to rabi season which results in the production of potato being spread over two seasons thereby getting a higher price for potato during kharif harvest. However, potato grown only under irrigated condition can be shifted to rabi from kharif.

Rabi crop however showed an increasing trend in prices, increasing from Rs.320 at the time of harvest to Rs.491 three months after harvest. Thus the results suggest storing potato during rabi season

is feasible. This may be because only two districts namely Bangalore and Kolar produce potato during rabi season, as such there is demand for the produce throughout the year in the state and the harvested produce is supplied to all the markets.

Financial feasibility analysis was also conducted for local storage structures to know the financial feasibility of investing in local storages. The net cash flow showed a decreasing trend in all three cases under study which is due to the decreasing discounting factor.

#### **5.6.2.4 Evaluation of investment in local storage structure**

The results of the financial feasibility analysis of local storage structures for different months of storage are presented in Table 4.28.

##### **a) Net present Value (NPV)**

The NPV was positive for all months under study indicating the viability of investing in local storage structure by farmers. The high NPV obtained at the end of 10 years is mainly due to the high returns and low cost incurred in maintaining the structure.

##### **b) Benefit Cost Ratio (BCR)**

From the Table 4.28, it could be seen that, the BCR was 5.35 for one month storage which subsequently increased to 11.07 and 15.84 on storing for two and three months respectively. The results showed that storing potato for longer duration under conditions of increasing prices

was feasible. The high BCR obtained on increasing the duration under storage was mainly due to increasing returns and low investment.

**c) Internal rate of Return (IRR)**

From Table 4.28, it could be observed that the IRR increased from 87 per cent for one month storage to 258 per cent for three months storage duration. This is mainly because of the increasing returns earned per quintal of storage coupled with constant establishment cost.

**d) Pay Back Period (PBP)**

The Pay Back Period for one month storage of potato in local storage structures was 1.2 years which decreased to five months on storing potato for three months on account of higher net returns obtained on storing potato for three months.

The high returns were obtained as prices tend to increase during the lean season compared to harvesting period. It was also observed from Table 4.28, that as the lean season advances the prices were found to be increasing. It was observed from the discussion with the farmers that they were inclined to store their produce for a longer period to reap higher prices. They have been following this practice over many years and got the benefit of price advantage for storing. As the investment in storage structure was lower and the benefits accrued were higher, naturally the financial tests namely are viz., NPV, BCR, IRR and PBP were found to be viable. Thus local storage structures are economically and financially viable for investment by farmers. There is thus a need for

encouraging farmers to embrace local storage for obtaining larger returns for their produce.

### **5.6.3 Cost of storage**

The cost of storage in potato was analysed to understand the economic benefits realized on storage. The economics was worked out by calculating the price difference obtained per quintal of potato between the time of harvest and the end of storage period viz., one, two and three months after harvest (MAH).

It could be observed from Table 4.29, that the major costs in storage of potato in cold storage for a period of one month were storages charges (42.67 per cent) and losses involved in handling, storage and transit (30.61 per cent) for kharif crop. In the case of local storage structures, the main component was involved in handling, storage and transit (62.92 per cent) of the total cost and cost of storage (17.82 per cent). The difference in charges for cold and local structures worked out to be Rs.2.05 for one month period. The higher cost in the case of cold storage was mainly due to higher cold storage charges and cost incurred for transportation of potato to cold storage from farm and associated cost of loading and unloading at cold storage.

In the case of rabi season, it could be observed that there was a difference of Rs.9 between cold storage and local storage charge. This difference is mainly due to the higher storage charges in case of cold storage and cost incurred for transportation of produce from farm to cold

storage unit and associated cost of loading and unloading at cold storage. The above results are in conformity with a pilot study by Dahiya *et al.* (1994) which showed that the storage cost was Rs.51.47 per quintal. It comprised Rs.26.67 as cold storage charges, Rs.4.35 interest on the value of potato stocked in cold storages and Rs.20.45 as over head charge such as transportation cost, marketing cost etc.

Handling, storage and transit accounted for a major part of cost in cold storage for both seasons. Hence efforts need to be made to reduce the losses involved in handling, storage and transit by scientific handling and packing of produce from farm to final consumer. In the case of local storages, the major cost item was the losses incurred in storage accounting for 62.92 and 55.63 per cent during kharif and rabi seasons, respectively.

The cost of storage in local and cold storage structures for a period of three months after harvest is presented in Table 4.31. It could be observed that the storage charges increased from Rs.75 per quintal one month after harvest to Rs.159.64 by the end of the third month after harvest. It was mainly on account of increase in monthly charges and increasing losses suffered under long duration storage.

The cost of storage in the case of local structure also showed an increasing trend from Rs.72.95 in the first month to Rs.155.13 by the end of the third month after harvest. The increase in cost was mainly due to higher losses (ranging from 59.18 to 62.92 per cent of the total cost),



incurred on storing potato for longer duration under local storage as observed from Table 4.31. It could also be observed that the cost incurred in storage in cold and local storage was not significantly large. This was mainly due to increasing losses in local storage which neutralized the higher cold storage charges.

The cost of storing potato during rabi season in local and cold storage structures is presented in Table 4.32. It was observed that there existed significant difference in storage charges between local and cold storage structures ranging from Rs.9 in the first month to Rs.20 by the end of the third month in favour of local storage. This may be due to the difference in the lower reference price base of Rs.320 per quintal.

From Table 4.31 and Table 4.32, it could be concluded that cost of storing of potato in cold and local storages was not significantly different during the kharif season while there existed larger difference in storage charges between the two structures during rabi season which may be due to the lower base price in rabi season compared to kharif.

The net returns obtained on storing potato during rabi season showed an increasing trend (Table 4.33). This was mainly due to the increasing price received per quintal during rabi season which may be due to the high demand for potato coupled with lower availability of potato during the post harvest period. The return on storage for the first month was negative as the price gain per quintal between harvest and one month after harvest was insufficient to meet the expense involved in

cold storing potato. It could be observed from Table 4.33, that net gain showed an increasing trend due to increasing price per quintal from the period of harvest.

In the case of Kharif crop the prices per quintal of potato showed a decreasing trend. This is because majority of the potato crop is harvested during the kharif season which results in large scale arrivals in the market and subsequent fall in prices. Hence it is advisable that farmers who grow potato in kharif viz., Belgaum, Dharwad and Hassan, sell their produce immediately after harvest as storage function results in obtaining lower returns.

### **5.7 Analysis of market concentration of Chikkaballapur market**

The market structure analysis of Chikkaballapur market was analysed with a view of studying the buying concentration in the market. The results obtained using Lorenz curve and Gini concentration Ratio of 0.5834 revealed a fair degree of buying concentration in the market. It is evident from the fact that lowest 10 per cent of commission agents have 0.4129 per cent of volume of trade. The bottom 50 per cent of trader share 8.5729 per cent of share market while the top 20 per cent of trader's accounted for 45.2334 per cent of market share for potatoes which shows that the markets are concentrated in the hands a few commission agents.

The same pattern is reflected by the Gini concentration ratio which was 0.5834. This can also be visualized from the Lorenz Curve drawn (Fig

4.15). Although it would be desirable to have a market with a Gini concentration ratio approaching zero, such markets are extremely rare. It can be concluded that the market is concentrated in the hands of a few commission agents. This is noted because large commission agents gave higher prices to farmers compared to small commission agents who gave lower prices. This situation arises as smaller farmers with small quantity and of lower quality approached small commission agents who in turn sell it for consumption to traders in the local market. While large farmers with better quality produce transacted with large commission agents who sold it in turn to traders coming from Bangalore market and as such farmers received higher prices. This caused the market to have a moderately high concentration. Mitrannavar (1997) found that in Hubli and Belgaum wholesale market concentration using Gini's coefficient was 0.243 and 0.278, respectively.

## **5.8 Direction of trade and export competitiveness of potato**

### **5.8.1 Direction of trade and changing pattern of exports**

The export promotion policy of a country must be in tune with the fast changing and dynamic international markets for commodities. Hence it would be of interest to document the changes that perhaps aid in export promotion policies. Though it would be difficult to pinpoint the nature of these changes and its directions, Markov chain analysis provides a probability approach in broadly unraveling the changes. Estimation of transitional probability matrix is central to Markov chain

analysis. It indicates the direction of the changes which helps to decide whether the changes are on the desirable directions or if changes are needed to boost sales to a particular market.

The direction of trade in potato export from India was studied using markov chain analysis. The probability of market retention, gain or loss is based on the transitional probability matrices presented in Table 4.35.

The results revealed that UAE and Sri Lanka are extremely loyal markets for Indian potato exports as indicated by diagonal element values of 0.3541 and 0.9821. Sri Lanka retained 98.21 per cent of its share in addition to gaining 63.14 per cent of other countries' share. UAE gained 21.72 per cent of Nepal and 13.14 per cent from Mauritius share in addition to retaining 34.51 per cent of its share in Indian potato export. Nepal, Singapore and Malaysia could not retain their share of Indian exports; however Nepal gained 43.06 per cent from UAE and 14.21 from other countries, Singapore gained 3.90 per cent from Mauritius and lost 100 per cent of its share to other countries while Malaysia gained 6.47 per cent from UAE during the same period. Mauritius in addition to retaining 1.41 per cent of its export share also engulfed 23.86 per cent of Nepal and 100 per cent Malaysia share of Indian potato export. Thus it may be concluded that Sri Lanka and UAE are very loyal markets for Indian potato which may be due to similar culture and consumption pattern of large migrated Indian population to these countries.

### **5.8.2 Projection of Indian potato exports to major importing countries**

The export shares of Indian potato to different countries were predicted for different time periods such as 2001, 2005 and 2010 by using one step, five steps and ten step transitional probabilities, respectively. The one step transitional probabilities are used with n-step transitional probabilities to predict the export shares during 'n' years from the present. These 'n' step transitional probabilities indicate the possibility that exports will switch over from one country to another country and also helps to understand the probability of import loyalty of a country after 'n' years from the present.

The prediction revealed that Sri Lanka will be the largest importer during 2001, 2005 and 2010 period with 71.71, 86.95 and 91.55 per cent share, respectively of Indian potato exports. The share of the rest of the importing countries is predicted to fall from its existing level. This may be due to increasing competition from other potato producing and exporting countries like Pakistan, USA and Holland. This could also be due to falling productivity of Indian potato production which would render insufficient quantity for export on satisfying the internal demand. Thus overdependence on a single market coupled with falling shares in existing markets would be a recipe for disaster for Indian potato exports. This necessitates the need for identifying new markets, conducting study to understand the consumer's preferences of each export market with reference to taste, appearance, cooking quality of potato and developing varieties suitable for exports.

Trade competitiveness basically depends upon the level of domestic prices relative to international prices. In its simplest form trade competitiveness, for say exports, can be measured by comparing domestic prices with international price expressed in domestic prices net of freight, transport and related costs involved in taking produce from exporting country to the importing country. If domestic price of any commodity is lower than the net export price then the commodity is export competitive otherwise it is not export competitive. Similarly, under importable scenario, if domestic price is lower than international price plus transportation, freight, insurance, and other costs involved in taking produce from foreign market to domestic market then domestic produce is import competitive otherwise it is not import competitive. It should be intuitively clear that any commodity that is export competitive is always import competitive and a commodity that is not import competitive can't be export competitive. However, there can be situations when a commodity is not competitive for export but it can compete with import. This is because of the reasons that for relevant price for export (FOB price) are lower than international price whereas relevant price for imports (CIF price) is higher than international price to the extent of cost of transportation, freight, insurance etc.

The simple concept of domestic price relevant to international price has been further refined and made more sophisticated by taking into account cost of production and other factors affecting comparison of

competitiveness and to take care of various distortions in factor and product prices. This way, there are two kinds of measures which have been widely used to reveal trade competitiveness. These are:

- a) Nominal Protection Coefficient (NPC)
- b) Domestic Resource Cost (DRC)

These measures are generally used to find the level of protection/dis-protection and level of government intervention in different commodities while DRC has been generally used to measure efficiency and comparative advantage in production vis-a-vis export/import of various commodities. Based on these measures one can find how resources should be re-allocated among different uses to improve their efficiency and to increase return to these resources. These measures have also been used to reveal competitiveness for export and import. The effect of protection, government intervention and policy changes like change in tariff or free trade is in turn measured either using partial equilibrium models based on framework of producers surplus and consumer surplus or more sophisticated general equilibrium models.

#### **a) Nominal Protection Coefficient (NPC)**

The average NPC for the period 1999 – 2002 under exportable hypothesis was 1.395, which indicates a high level of protection coefficient. This implied that the level of incentives were significantly higher under exportable hypothesis than that estimated under

importable hypothesis. Thus NPC value higher than unity suggests Indian potato is uncompetitive in the international market and is not an efficient export crop.

The average NPC value under importable hypothesis of 0.383 imply that domestic prices received by farmers were below the international prices and potato cultivators in the study region were dis protected to some extent or in effect taxed on the pricing front compared to the free trade situation. This conclusion is true since the NPC indicates the incentives to produce a commodity if NPC is greater than one, then the commodity is protected. If it is less than unity, then the commodity is dis-protected or in effect taxed. The anti- protectionist results indicated by the lower NPCs of potato implies that the potato was an efficient import substitute but for the barriers that delineate the domestic and the world market. Kumar *et al.* (2001) concluded that the NPC for potato is largely above one (1.23) when the Official Exchange Rate (OER) is used while it's below one (0.97) when Shadow Exchange Rate (SER) is used, indicating moderate export competitiveness.

#### **b) Domestic Resource Cost (DRC)**

The DRC ratio worked out to be less than unity (0.27), indicating high export competitiveness of potato. Although NPC proved that Indian potato exports are uncompetitive, the lower than unity DRC of potato indicates high export competitiveness. This may because NPC is highly influenced by the variations in the exchange rate. The high export potential indicted by the less than unity value of DRC needs to be



exploited further by increasing the marginal productivity of labour. The current level of potato productivity in the state must be improved to allow potato export from India to be competitive in the international market.

These results when compared give contrasting pictures. While the NPC indicates a lack of competitiveness, the DRC shows a high degree of competitiveness. This indicates that the state has the potential to gain a competitive edge in potato exports if it can increase the productivity of its non-tradable inputs. This could be through R&D and the like. The reason why there is no competitiveness at present is because the factor prices far exceed the contribution (MVP) of each factor to the output value.

According to Gulati *et al.* (1996) NPC and DRC are static in nature and should only be taken as an indicator to measure competitive advantage. Though considered a very useful measure, NPC is criticised as a measure which is highly influenced by the variations in the exchange rate. Hence, the devaluation policy of a country's government often helps enhance the competitive advantage. Sudha (2000) in her study on export competitiveness of Hi tech floriculture in Karnataka also reported similar findings.

## **5.9 Logistics model for efficient marketing of potato**

An optimum transportation network for potato was designed using linear programming technique. Two models were constructed for the study, one involving cost minimization and the other involving profit maximization.

The coefficient for this model included only the cost involved for transportation from source to destination. The result suggested that farmers must sell their produce to their respective markets except in the case of Kolar district farmers so as to minimize the cost of transportation. Kolar farmers have a location advantage to Bangalore market which is deficit in supply of potato from its own district. Hence Kolar farmers should sell their produce to Bangalore market and thereby minimize the transportation charges.

**5.9.2 Profit Maximisation model**

This model aims at maximizing the profit for farmers. As per the results of this model, Hubli farmer should sell their produce in Hubli market as well in Belgaum market so as to maximize their profit. As Belgaum market was located strategically at the intersection of Maharashtra and Goa state it catered to demands of these markets too and as such it witnessed higher demand as well offered higher price for produce. Kolar farmers should sell their produce to Kolar and Bangalore markets to maximize their profit. As Bangalore district is deficit in production to a tune of 1.30 lakh quintals, this quantity could be made available by Kolar farmers. The model however failed to explain where the excess potato production of Hassan was to be sold. This is because Hassan potato crop was harvested when no other crop in India was

harvested and as such potato from Hassan made its way to such distant markets like Delhi, Chennai and Hyderabad.

The results from this study only serve as an approach to studying commodity flow between production and markets. It would be desirable to model the transport system more comprehensively using data on all aspects of production and marketing on a national basis to achieve a more meaningful transportation model.

# *Summary and Policy Implications*

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## VI. SUMMARY AND POLICY IMPLICATIONS

Potato is an edible starchy tuber produced by certain plants of the Genus – Solanum and Family-Solanaceae. Today, potato is the 4<sup>th</sup> most important food crop in the world exceeded only by wheat, rice and maize for human consumption. Potato ranks fifth in area under cultivation, fourth in production tonnage and is cultivated in about 130 countries sustaining three-fourths of the world population. Some of the leading potato producing countries are China, Russian Federation, Ukraine, Poland, Belarus, US, Germany, Turkey and the Netherlands. The Portuguese introduced Potato into India in the early part of the 17<sup>th</sup> century. In India potato is grown mainly in the Indo-Gangetic plains, consisting of the states like Punjab, Haryana, Uttar Pradesh, Bihar, West Bengal and the Union Territory of Delhi which is considered as the potato bowl of the country. India is the fourth largest potato producing country with a production of 25 million tonnes from 1.34 m ha. India's productivity of 18.6 MT per ha is higher than the world average of 16.4 MT per ha.

Karnataka is one of the important potato growing states in Peninsular India. Potato is one of the main crops in six of its twenty-seven districts. The state's agro ecology favours its cultivation during two seasons a year. Potato is predominantly grown in Bangalore, Belgaum, Chikmagalur, Dharwad, Hassan and Kolar districts. It is mainly grown as

Kharif crop in Belgaum, Chikmagalur, Dharwad and Hassan districts. whereas it's grown as a rabi crop in Kolar and Bangalore districts. The rabi crop is irrigated, whereas the kharif crop is totally rain fed. Potatoes produced in Kharif account for the major proportion (70 per cent) of the potatoes produced in Karnataka. Hassan District stands first in area and production followed by Belgaum and Kolar districts.

Potato is mainly sold by farmers in the Agricultural Produce Market Committee (APMC) markets. The major APMC markets for potato are Bangalore, Hubli, Belgaum, Hassan, Chikkaballapur and Kolar. Bangalore attracts the largest share of arrivals of potato among these markets. The major arrivals of potato in these markets are during October and March months corresponding to kharif and rabi crop harvest. During off-season, potato from other states like Punjab and Uttar Pradesh arrive in these markets.

Potato being a highly perishable commodity requires storage under ambient condition. In Karnataka, potato is stored by farmers on the farm in local storage structures as well as in cold storage houses. The storage function plays an important function of making available the produce in off-season as well preventing glut in the market immediately after harvest.

Stable prices are important indicators of the level of economic growth and they depict the directions for future investments in the economy. Fluctuations in prices can be attributed to the instability of

production, risk in production, level of adoption of technology, market infrastructure, supporting-marketing arrangements, Government policy with respect to price support policy, procurement policy, export-import policy etc. Price stability is a precondition for stabilizing production of semi-perishable crops such as potato. Hence the need of the hour is to examine the constraints responsible for such fluctuation in prices and production of potato. Infact, economically damaging price fluctuations have been attributed to faulty policy initiatives in India. The infrastructure facilities available are insufficient for effective handling of the present level of production. The supporting infrastructure like processing facilities, storage facilities, network of rail and road, marketing finance vis-à-vis other facilities is found to be inadequate. It is also important to workout the investment requirements on the creation of these facilities through which one can visualize the benefits accrued from stability in price and production.

In view of the above situation the study was undertaken with the following objectives

### **Objectives**

- 1) To analyse the trends in arrivals and prices of potato in major markets of Karnataka
- 2) To study the seasonal pattern of market arrivals and prices of potato

- 3) To study the extent of market integration among major markets for potato
- 4) To identify the constraints and potentials in the production of potato and work out feasibility of production of uniform grades and quality of potato.
- 5) To ascertain the gaps in the level of infrastructure facilities like storage, processing, transportation and marketing finance
- 6) To ascertain the constraints in the full exploitation of the capacities of the existing infrastructural facilities and workout feasibilities of absorption of increased production of potato.
- 7) To ascertain the market structure in marketing of potato and to develop appropriate model of market structure for their efficient marketing
- 8) To identify the potentials for export of potato both in raw and processed form
- 9) To suggest appropriate logistics model for efficient marketing of potato
- 10) To suggest appropriate policy measures for management of production and prices of potato in Karnataka.



## Methodology

The study utilised both primary and secondary data to fulfill the objectives. Primary data were obtained from farmers, transporters, commission agents and exporters. However, a sampling frame was constructed only in the case of farmers, for which a structured, pre-tested schedule was used to gather cultivation data. Open-ended schedules were used in the remaining cases and the personal interview method was used for all.

In the case of sampling frame for the farmers, farmers from all the selected districts viz., Bangalore, Belgaum, Dharwad, Kolar and Hassan were selected and from each district two taluks were selected. Two villages in each taluk were chosen, based on the criteria of area dominance. Five potato growers were chosen at random from each village making an overall sample size of 100 farmers.

Secondary data and information were extensively used from sources like KSCMF, KAPPEC, KSAMB, APEDA, DGCIS, NHB and selected APMCs.

The following analytical techniques were used in the study.

- 1) Exponential form of growth function was used to estimate the trend in arrivals, prices, area, production and productivity of potato.

- 2) TSCI technique was used to analyse the seasonal pattern in arrivals and prices of potato.
- 3) Correlation analysis was used to analyse the level of integration among potato market in Karnataka.
- 4) Simple tabular analysis was used to determine the constraints in production of uniform grade of potato and to ascertain the gaps in the level of infrastructure facilities.
- 5) Financial tools like NPV, BCR, IRR and PBP were used to determine the financial feasibility of investing in cold storage and local storage structures.
- 6) Lorenz curve and Gini coefficient ratio were used to analyse the market structure of potato market.
- 7) Markov chain analysis was employed to know the direction of potato exports.
- 8) To study the export competitiveness of potato NPC and DRC techniques were employed.
- 9) Linear programming technique was used for formulation of an optimum transportation model for potato marketing in Karnataka.

## Findings of the study

- 1) All the markets showed positive and significant growth in arrivals of potato except Hubli market. The increased arrivals are due to increase in area under potato in the state coupled with the use of high yielding varieties of potato by farmers. While in the case of prices except Bangalore market, rest of the markets showed a positive and significant growth which may be due to the increasing population. The area and production of potato showed an increasing trend, which may be because of shift in area under other crops to potato and the use of high yielding varieties by farmers in the study area. However, the productivity showed a decreasing trend which may be due to non adoption of appropriate scientific potato production practices by farmers.
- 2) The seasonal indices of arrivals in potato showed seasonality in arrivals of potato in all markets. It clearly shows that potato farmers rushed their produce for sale immediately after harvest without adopting storage practices. In the case of prices, it could be seen that prices decreased immediately in the post harvest period. This clearly indicated that the prices of potato were mainly influenced by their arrivals in these markets in accordance with the law of demand and supply.
- 3) Market integration analysis of potato markets in Karnataka revealed that all markets were integrated with one another although the level

of integration was different for each market which may be due to the availability of good communication facilities and associated transportation infrastructure like rail and road lines to markets.

- 4) The unawareness and non availability of Package of Practice (POP) books was considerably high among all the farmers in all the selected districts. Hence, efforts need to be made to popularize the usage of Package of Practice for scientific farming of potato, which would help in increasing the productivity of potato in the state.
- 5) Farmers were satisfied with timely and adequate availability of potato seed tubers in the state which indicated that the seeds procured by traders from Jalandhar were available to the farmers at the right time and sufficient quantity for planting of the new potato crop.
- 6) There were major differences in the opinion of farmers and scientist regarding the reasons for non-uniform production of potato. While farmers opined the reason was due to absorption of all the nutrients by the first tuber, the scientist claimed it was mainly due to the genetic nature of the plant.
- 7) The farmers opined that the major lacuna in APMCs was absence of temporary storage facilities and lack of grading and physical facilities in all the markets. In all the selected markets, farmers were satisfied with the transaction facilities, although a small percentage

of them reported faulty system of weighing, unreasonable commission charges and prolonged payment of cash for produce.

- 8) Farmers sold their produce through commission agents as they received immediate cash payments, better prices, due to smaller quantity of produce, low marketing costs and receipt of information on market situation. A few farmers who had social ties with the intermediary were getting advance loan for production, in addition to storage and transportation facilities.
- 9) Potato is stored by farmers in local as well as in cold storages in Karnataka. The NPV, BCR, IRR and PBP for cold storage were found to be financially viable for investment. The net cash flow and the discounted net cash flow were positive at all levels of capacity utilisation viz., 42, 50, 60 and 70 per cent indicating the profitability of investing in cold storages. In the case of local storage also the financial feasibility analysis viz., NPV, BCR, IRR and PBP showed that the investment were viable
- 10) The cost of storage in local and cold storages for kharif and rabi showed that losses in handling, storage and transit and storage charges accounted for a major part of cost in local as well as in cold storages. The cost of storing of potato in cold and local storage was not significantly different during the kharif season while there existed larger difference in storage charges between the two

structures during rabi season which may be due to the lower base price in rabi season compared to kharif.

- 11) The net returns to storage for rabi and kharif crop showed that the returns were negative if potato was stored in kharif season due to falling prices while in rabi season the returns were increasing on account of lower production of potato during rabi season.
- 12) The market structure for potato in chikkaballapur market was found to be moderately concentrated in the hands of few commission agents.
- 13) Sri Lanka and U.A.E are very loyal markets for Indian potato as indicated by the retention of their previous shares of potato exports from India by more than 98.21 and 34.51 per cent, respectively.
- 14) The projected import shares of different countries showed Sri Lanka and UAE would continue to be the stable importers of Indian potato during the period 2001- 2010.
- 15) The Nominal protection Coefficient (NPC) under exportable hypothesis was above unity while the NPC under importable hypothesis was below unity. The NPCs thus suggest that the Indian potato is uncompetitive in the international market and is not an efficient export crop. The DRC ratio worked out to be less than unity (0.27), indicating high export competitiveness of potato. This indicates that the state has the potential to gain a competitive edge

in potato exports if it can increase the productivity of its non-tradable inputs.

- 16) The results of the cost minimization transportation model suggest farmers must sell their produce to their respective markets except in case of Kolar district farmers, who could sell their produce to Bangalore, so as to minimize the cost of transportation. In the case of profit maximization model, Hubli farmer should sell their produce in Hubli market as well in Belgaum market so as to maximize ones profit. Similarly, Kolar farmers should sell their produce to Kolar and Bangalore markets to maximize their profit.

### **Policy Implications**

- 1) The findings of the study revealed that the arrivals and prices of potato in major markets showed an increasing trend. Similarly the area and production of potato showed increasing trends. However, the productivity of potato showed a negative trend. This calls for effort to increase the awareness among farmers about scientific cultivation of potato using recommended practices. This can be done by conducting various promotion measures such as farmers meeting, demonstration and Krishi Mela for potato crop especially by the research institution which are situated in the potato growing areas.
- 2) The market integration study showed that the major potato markets in Karnataka had a high degree of integration. However, the extent

of integration as indicated by the correlation coefficient showed that there exists a scope for increasing the extent of integration by improving the communication facilities such as market information, transportation, etc., which needs to be done. The agencies to bring about such improvement include the Horticulture department, marketing department and transport authorities.

- 3) The major constraints in the production of uniform quality of potato in the state are with respect to the soil type and genetic factors. Though the genetic factor needs to be tackled at the researcher level the farmers can tackle the other factor by adopting suitable varieties for their soils. The farmers in North Karnataka who cultivate in Black soils should go in for Kufri Pukhuraj a suitable variety for this soil type rather than Kufri Chandhramuki and Kufri Jyothi which are being adopted at present.
- 4) Transportation as an infrastructure facility is found not to be a constraint in marketing of potato. However, the cost of transportation adds to the marketing cost. The farmer need to reduce the burden of transportation cost by pooling the small quantity of their produce and engaging transport vessels such as tractors and trucks to reduce the per unit cost of transportation.
- 5) In the market yard temporary storage space is the major constraint faced by the farmer. Hence the market committees in the major market should invest additional funds to create temporary storage



structure to assist the farmers in marketing their produce in a better way.

- 6) Organised processing of potato is surprisingly non existent in Karnataka as seen in the records of the district industry centres of the five districts studied. Processing activity is restricted to the tiny house hold sectors whose data are not even recorded. There is a need to conduct an exhaustive survey on the existing tiny processing unit as in Karnataka by the Directorate of Industry and Commerce and brings these industry under the ambit of Small Scale Industry thereby these units can procure potato in an organised way and help stabilise the prices of potato especially during glut season.
- 7) The market finance scheme of the Government of Karnataka is not utilised by potato farmer who expressed ignorance on its availability during the interviews. This calls for aggressive extension campaign by the state departments of agriculture marketing to popularise the market finance scheme (pledge loan scheme).
- 8) The study indicated that storing kharif potato is not a profitable proposition for the farmer since the prices of potato during the 1,2 and 3 rd month after harvest continuously declined as indicated by the past 5 year data. Hence it is advisable for the farmers not to store the kharif potato and sell immediately after harvest instead.
- 9) Storing rabi potato crop is found to be profitable to the farmers. Hence farmers may store their rabi potato crop up to three months

after harvest and consequently obtain the economic benefits of storage. This also leads to the point that as far as it is feasible the farmers may shift the area under potato from kharif season to rabi season to get better economic gain from the potato cultivation.

- 10) The investment on both the cold storage structure and local storage structure were found to be feasible hence any agency interested in investing on these structures must be encouraged to invest in the storage structure. These may include individual entrepreneur, group of framers and even the farmer's cooperatives in the rural are. Such agency should also avail the back ended 25 per cent subsidy which are given to storage units by National Horticulture Board and NABARD.
- 11) The extent of capacity utilisation in cold storage units in marketing outside Bangalore district was found to be about 42 per cent which decreases the profitability in running their units. Hence these units may by different promotion measures popularize the use of cold storage structure for other commodities which need cold storage and increase the capacity utilisation and thereby improving their profitability.
- 12) The market structure study showed that there is a moderate concentration in market for potato in Chikkaballpur market which may be identical in other markets too. This tendency is to be nipped by encouraging the farmers to get distributed over the available

traders in the market so as to bring about the distribution of trade closer to the Egalitarian line. This will have to be done by the official's in the market yards.

- 13) The Markov chain analysis hinted that Indian potato is likely to loose out its export market in countries such as Nepal, Malaysia, Mauritius and Singapore. Hence special efforts are needed by agencies like NAFED, APEDA and KAPPEC to tap the market potential and improve the export performance in the future.
- 14) The result of NPC and DRC analysis indicated that if potato is to be export competitive, the cost structure of potato cultivation needs to be reduced. This reiterated the suggestion made at (1) above that there is a need to increase the efficiency in production by agencies mentioned there in.
- 15) The result of the logistic model suggest that the transport of potato between markets must be restricted to

Hubli – Belgaum

Kolar – Bangalore

and the potato grown in Hassan district may be marketed not only in any place in Karnataka but also outside the state.

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# *Appendices*

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**DEPARTMENT OF AGRI-BUSINESS MANAGEMENT**  
**COLLEGE OF AGRICUTLURE, DHARWAD**  
**“Infrastructure Policies for price stabilisation for potato and onion in Karnataka”**

**SCHEDULE-A**

No:

Date:

**I General Information:**

- |                            |                           |
|----------------------------|---------------------------|
| a. Name of the respondent: |                           |
| b. Village :               | c. Age:                   |
| e. Taluka:                 | d. Education:             |
| g. Main occupation:        | f. Annual income:         |
|                            | h. Subsidiary occupation: |

**II Farm Size: (acres)**

- a. Total area
- b. Dry
- c. Wet
- d. Garden

**III Details of vegetables grown**

| Vegetables | Variety | Season | Area | Yield | Dry/Irri./Garden |
|------------|---------|--------|------|-------|------------------|
| 1.         |         |        |      |       |                  |
| 2.         |         |        |      |       |                  |
| 3.         |         |        |      |       |                  |
| 4.         |         |        |      |       |                  |

**Material possession of the farmers**

| PARTICULARS                      | NO. | PRESENT VALUE |  |
|----------------------------------|-----|---------------|--|
| 1. Land                          |     |               |  |
| 2. Building                      |     |               |  |
| 3. Machinery and Farm Implements |     |               |  |
| 4. Livestock assets              |     |               |  |
| 5. Others                        |     |               |  |

**Cost of cultivation potato / onion**

| Input factors                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Unit | No./qnty. | Cost/unit (Rs.) | Total Cost (Rs.) |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-----------|-----------------|------------------|
| <b>1. Human Labour</b><br>a) Sowing<br>b) Spreading of FYM and fertilizer<br>c) Weeding<br>d) Spraying of PPC<br>e) Harvesting<br>f) Grading and cleaning<br>g) Packing loading and unloading<br><b>2. Bullock Labour</b><br>a) Preparatory tillage<br>b) Inter cultivation<br>c) Harvesting<br><b>3. Seeds</b><br><b>4. Manures</b><br><b>5. Fertilisers</b><br>a) N<br>b) P<br>c) K<br><b>6. Irrigation</b><br><b>7. Plant protection chemicals</b><br><b>8. Land Rent</b><br><b>9. Others</b> |      |           |                 |                  |

**Constraints in production of uniform grade/quality of onion/potato**

a) Availability of seeds

Timely / non timely  
 Adequate / inadequate

b) Quality of seeds

Good quality / adulterated

c) Selection of seeds

Local / improved  
 Name of the variety \_\_\_\_\_

d) Source of seeds

Owned / purchased

e) Reasons for not producing uniform size of produce

- i.
- ii
- iii.
- iv.

## f) Constraints in Adoption of prescribed package of practices

- i.
- ii.
- iii.
- iv.

## Storage of onion / potato

1. Do you store the produce after harvest yes/no

A) If yes

- a) Type of storage structure
- b) Items of cost

- i.
- ii.
- iii.

c) Duration of storage

d) Do you get remunerative price after storage yes / no

B) If no give reasons

- a)
- b)
- c)

**If stored at cold storage:**

- a) Cost per unit
- b) How much quantity do you store
- c) Are you satisfied with the facilities provided at cold storage unit

**Sources of finance:**

**For production:**

owned/ borrowed

If borrowed

Public/private

Amount \_\_\_\_\_

Rate of interest \_\_\_\_\_

**For marketing:**

**Source** \_\_\_\_\_

Amount \_\_\_\_\_

Rate of interest \_\_\_\_\_

**MARKETING OF POATATO / ONION**

- IV. a. The nearest markets from the village:
- b. Distance from the village:

**V. Why you are selling to particular agency? Give reasons**

| Sl.No. | Particulars                                 | Commission agent | Co-op society | Others (Specify) |
|--------|---------------------------------------------|------------------|---------------|------------------|
|        | Previous agreements with the intermediary   |                  |               |                  |
|        | Immediate cash payments                     |                  |               |                  |
|        | Receive competitive prices (better prices)  |                  |               |                  |
|        | Small quantity of produce for sale          |                  |               |                  |
|        | Lack of information on marketing practices  |                  |               |                  |
|        | Low marketing costs                         |                  |               |                  |
|        | Social ties with the intermediary           |                  |               |                  |
|        | Getting information on the market situation |                  |               |                  |
|        | Advances loan for vegetables production     |                  |               |                  |
|        | Getting storage facilities                  |                  |               |                  |
|        | Getting transport facilities                |                  |               |                  |
|        | Payments are made in advance                |                  |               |                  |
|        | Any other (specify)                         |                  |               |                  |

**VI** Are you getting any guidance on the market situation (prices/arrivals)? Give Details

**VII** Do you feel that regulation of vegetable marketing by Government agency will help to set up fair price and solve your marketing problems? Yes/No  
Give reasons

**VIII.** At present what problems (or inconveniences) you are facing in marketing of vegetables

- a) Transportation facilities
- b) Storage facilities
- c) Facilities in mandi
- d) Space for keeping the produce is enough/not enough
- e) System of weighing – Faulty/correct
- f) Deductions while selling- legal/illegal
- g) Temporary storage facility at mandi- present / Absent

SCHEDULE – B**COMMISSION AGENT**

- I. Name of the respondent
  - a. Educational level
  - b. Location
  - c. Age
- II
  - a. Vegetables usually handled
  - b. Are you dealing commodities other than vegetables Yes/No
- III From how long you are in this business?
- IV. Do you make outright purchases in the field and transport it on your own?  
Yes/No
- V. What facilities do you provide to the producer who brings his produce for sale/  
Storage/Lodging/Boarding/Transport/
- VI. Investment made in the business
  - a. Owned amount
  - b. Borrowed amount
  - c. Interest rate
- VII
  - a. Knowledge of different qualities/grades/standards of different vegetables is  
little/average/perfect
  - b. Do you know the arrivals/prices of different vegetables prevailing in
    - i. Local market Yes/No
    - ii. Other markets Yes/No
- VII If regulation is enforced what are the benefits/inconveniences in your opinion  
(state reasons)
- IX difficulties you are experiencing in vegetable marketing
  - 1
  - 2
  - 3
  - 4
- X Do you grade the vegetables? Yes/No  
If yes, the basis of grading (for each vegetable)
- XII Shop rent (including electricity and other charges)
- XIII License fee





**SCHEDULE – C****POTATO/ONION EXPORTER**

1. Name of the potato/onion exporters/merchant:
2. Address:
3. Details about potato/onion exports:

| Year | Quantity<br>purchased (qtls) | Export quantity<br>(Qtls) | Export value<br>(Rs) | To which country the<br>commodity exported |
|------|------------------------------|---------------------------|----------------------|--------------------------------------------|
|      |                              |                           |                      |                                            |

4. Freight charges:
5. Port handling charges:



## **INFRASTRUCTURE POLICIES FOR PRICE STABILISATION OF POTATO IN KARNATAKA**

**AUSEPHARAMPIL JOSON JOSE**

**2002**

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**MAJOR ADVISOR**

### **ABSTRACT**

Karnataka is one of the important potato growing states in India. Primary and secondary data were used in the study. All the markets showed positive and significant growth in arrivals and prices of potato. The area and production of potato showed an increasing trend and productivity showed decreasing trend. The seasonal indices of arrivals and prices of potato showed seasonality in all markets. The market integration model revealed high level of integration between all the markets. The unawareness and non availability of Package of Practice books was considerably high among all the farmers. Farmers were satisfied with timely and adequate availability of potato seed tubers in the state. Farmers opined absorption of all nutrients by first tuber as reason for non uniform tubers while scientist claimed it to genetic nature.

The major lacuna in APMCs was absence of temporary storage facilities and lack of grading and physical facilities in all the markets. In all markets, farmers were satisfied with the transaction facilities. Farmers preferred to sell their produce through commission agents. The NPV, BCR, IRR and PBP for cold storage and local were found to be financially viable for investment. The net returns to storage for rabi and kharif crop showed that the returns were negative if potato was stored in kharif season. The market structure for potato in Chikkaballapur market was found to be moderately concentrated. Sri Lanka and UAE are very loyal markets for Indian potato. The NPCs suggest that the Indian potato is uncompetitive in the international market and is not an efficient export crop. The DRC ratio indicated high export competitiveness of potato. Transportation model suggest that the transport of potato between markets must be restricted to Hubli - Belgaum and Kolar - Bangalore.