Agricultural Constraints in India and Gujarat, Major Problems of Rice Cultivation in Gujarat
SECTION - I

AGRICULTURAL CONSTRAINTS IN INDIA AND GUJARAT
This chapter has been categorized into two sections. Section I provides the agricultural constraints in India and Gujarat and also gives the constraints of paddy cultivation. Section II analyzes the instability in productivity of rice at the district level as well as Gujarat as a whole. The strategy of rice cultivation has also been presented in this section.

SECTION - I
CONSTRAINTS OF AGRICULTURE IN INDIA

The agriculture is said to be ‘gamble of monsoon’ because even today large area still depends on rainfall that is one of the main constraints of agricultural development in India as well as Gujarat. In spite of research and development in agricultural technology and techniques still agricultural growth depends on natural factors like rainfall, whether, flood and drought, various deceases of crops etc. and ground realities like illiteracy of farmers, scarcity of inputs and resources like capital and finance, availability of pure certified seeds varieties etc.

There are many constraints in agricultural sector; however, for the simplification of discussion, they are grouped into four categories viz. (1) General constraints (2) Technological constraints (3) Resource constraints and (4) Capital constraints. An attempt has been made in the subsequent parts to analysis these constraints.

(1) GENERAL CONSTRAINTS
(a) Pressure of population on Land

One of the major causes, of backwardness of Indian agriculture is the excessive pressure of population on land. India has about 17 per cent of the world population with only 2.4 per cent of the total area of the world. About 60 per cent of India’s total workforce is engaged in agriculture. This excessive pressure of population leads to fragmentation of land which ultimately results in small size of landholding and restricts farm practices. Therefore, farmers do not earn enough income to meet their basic minimum needs. Over three-fourth of operational holding are small and uneconomic and hence productivity in agriculture is externally low. (Bhargava B.K. and Vandana Sethi -2007).
Increasing population puts enormous pressure on the available natural resources and infrastructure, which becomes more and more fragile. The grain harvested area per person was 0.22 per hectare during 1950 in India and declined to 0.10 per hectare during 2000 (Ramasamy C.-2004).

(b) Rainfall Problem

In India only 30 per cent of net cropped area (NCA) enjoys high rainfall of 1150 mm and above, while 36 per cent of NCA receives rainfall below 750 mm. Therefore, farmers can not adopt high yielding varieties and modern technology on their farms because they require more use of water. Thus, the productivity of crops has been low in the low rainfall areas.

(c) Irrigation Constraints

Irrigation is considered to be the paramount factor that determines the performance of agriculture. The net irrigated area has increased substantially from 20.58 million hectares in 1950-51 to 53 million hectares in 1994-95. These is no appreciable improvement in it since the mid-1990s because of inadequate allocation of funds. Besides, the poor growth in surface irrigation has compelled farmers to rely heavily on groundwater irrigation. The increased dependence on groundwater irrigation increases the cost of cultivation. In spite of continued expansion in irrigation, nearly two-thirds of area under cultivation still depends on rainfall (Narayanamoorthy A.-2007, Bhargava B.K. and Vandana Sethi -2007). Due to irregular and insufficient rainfall and continuous discharge from underground water resources, there is depletion of the water table. This adds to cost of irrigation.

(2) TECHNOLOGICAL CONSTRAINTS

(a) Modern Varieties

Technology that supported and promoted the process of Green Revolution during 70s and 1980s, started showing signs of deceleration during 1990s. In the 1970s, agricultural production growth was growing at an average annual rate of 1.95 per cent., further it grew at 3.82 per cent per annum in the 1980s. Since 1990, production growth has been slow, growing at only 2.09 per cent per annum because of lack of upgradation of technology (Fan and Shenggen - 2002)
Technological stagnation has adversely affected the productivity of growth of crops in some states of India. It can be observed from the table nos. 3.1 and 3.2 that growth of productivity of rice, wheat and pulses marginally in states of India during 1970s, 1980s and 1990s. In case of rice the growth of productivity increased only in Bihar and Karnataka while its declined in remaining major rice growing states during the same periods. Wheat is an important food grain crop in India, however, the trend of growth of productivity declined in major producing states except Assam, Gujarat, Karnataka and West Bengal during given period. The growth of productivity of pulses at the rate of 0.98 per cent during 1970s, it increased to 1.57 per cent during 1980s and again declined to 0.49 per cent during 1990s. This productivity marginal declined in all major pulses growing states. Thus, modern varieties of various crops adversely affected the productivity.

Growth has remained either flat or has declined in the progressive states. This is due to differential levels of adoption of new technologies, varying degrees of water control, imbalances in infrastructure development and other factors. Differential levels of adoption of modern varieties are also one of the causes for stagnation in yield levels (Narayanamoorthy A. – 2007).
### Table 3.1:
**Productivity Performance: (Selected Crops)**

(Compound growth rate in per cent)

<table>
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<td>1.64</td>
<td>-0.50</td>
<td>0.86</td>
<td>0.61</td>
<td>-1.67</td>
<td>-2.19</td>
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<td>0.55</td>
<td>-1.45</td>
<td>2.00</td>
<td>3.93</td>
<td>1.58</td>
<td>0.61</td>
<td>-1.67</td>
<td>-2.19</td>
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<td>0.47</td>
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<td>-1.01</td>
<td>-1.62</td>
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<td>1.74</td>
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<td>0.01</td>
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<td>1.97</td>
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<td>1.39</td>
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<td>-0.66</td>
<td>1.32</td>
<td>-1.77</td>
<td>0.03</td>
<td>-0.35</td>
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</tbody>
</table>

India 1.65 3.56 1.10 1.87 3.09 1.81 -0.98 1.57 0.49

Source: Agricultural Statistics at a Glance, Ministry of Agriculture, GOI

### Table 3.2:
**Sustainability of Agricultural Growth in India during 1990s (Selected Crops)**

<table>
<thead>
<tr>
<th>Rice Productivity</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Declining</td>
<td>Increasing</td>
<td>Declining</td>
</tr>
<tr>
<td>Haryana</td>
<td>Andhra Pradesh</td>
<td>Andhra Pradesh</td>
</tr>
<tr>
<td>Jammu &amp; Kashmir</td>
<td>Assam</td>
<td>Jammu &amp; Kashmir</td>
</tr>
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<td>Madhya Pradesh</td>
<td>Bihar</td>
<td>Assam &amp; Kashmir</td>
</tr>
<tr>
<td>Orrisa</td>
<td>Karnataka</td>
<td>Kerala</td>
</tr>
<tr>
<td>Punjab</td>
<td>Bihar</td>
<td>Jammu &amp; Kashmir</td>
</tr>
<tr>
<td>Karnataka</td>
<td>Assam</td>
<td>Orrisa</td>
</tr>
<tr>
<td>Kerala</td>
<td>Bihar</td>
<td>Punjab</td>
</tr>
<tr>
<td>Madhya Pradesh</td>
<td>Bihar</td>
<td>Punjab</td>
</tr>
<tr>
<td>Maharashtra</td>
<td>Bihar</td>
<td>Punjab</td>
</tr>
<tr>
<td>Orrisa</td>
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<td>Punjab</td>
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<tr>
<td>Punjab</td>
<td>Bihar</td>
<td>Punjab</td>
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<tr>
<td>Tamil Nadu</td>
<td>Bihar</td>
<td>Punjab</td>
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<td>Uttar Pradesh</td>
<td>Bihar</td>
<td>Punjab</td>
</tr>
<tr>
<td>West Bengal</td>
<td>Bihar</td>
<td>Punjab</td>
</tr>
</tbody>
</table>

Source: Agricultural Statistics at a Glance, Ministry of Agriculture, GOI
(b) Chemical Fertilizer Use

There are indications that over and unbalanced use of fertilizers in the assured areas of irrigation is leading to declining input output ratio. It also adversely affects the micronutrient, soil quality and groundwater resources. The fertilizer use efficiency was 17.1 in 1970-71, but decreased to 10.3 in 1980-81 and 8.1 in 1988-89 and expected to decline to 6.5 in 2000 due to improper technique of application (Sankaran A. – 1990).

Table 3.3:
State wise Fertilizer Consumption and Imbalance in Use of Fertilizer - Selected States

<table>
<thead>
<tr>
<th></th>
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<th></th>
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<th></th>
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</thead>
<tbody>
<tr>
<td>Andhra Pradesh</td>
<td>27.9</td>
<td>8.9</td>
<td>2.7</td>
<td>39.5</td>
<td>90.99</td>
<td>37.69</td>
<td>11.37</td>
<td>140.05</td>
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<td>Tamil Nadu</td>
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<td>9.6</td>
<td>11.3</td>
<td>55.8</td>
<td>72.82</td>
<td>28.07</td>
<td>35.05</td>
<td>135.94</td>
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<tr>
<td>Gujarat</td>
<td>16.9</td>
<td>8.1</td>
<td>2.6</td>
<td>27.6</td>
<td>53.03</td>
<td>20.86</td>
<td>5.23</td>
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<tr>
<td>Madhya Pradesh</td>
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<td>7.4</td>
<td>24.26</td>
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<td>40</td>
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<td>3.7</td>
<td>3.1</td>
<td>18.1</td>
<td>42.43</td>
<td>18.42</td>
<td>8.91</td>
<td>69.76</td>
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<tr>
<td>Haryana</td>
<td>27.2</td>
<td>4.5</td>
<td>1.6</td>
<td>33.3</td>
<td>96.72</td>
<td>27.84</td>
<td>0.78</td>
<td>125.34</td>
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<td>Punjab</td>
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<td>19.1</td>
<td>3.9</td>
<td>82.2</td>
<td>128.13</td>
<td>36.97</td>
<td>2.36</td>
<td>167.46</td>
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<td>Uttar Pradesh</td>
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<td>6</td>
<td>2.9</td>
<td>37.6</td>
<td>80.94</td>
<td>20.15</td>
<td>3.45</td>
<td>104.54</td>
</tr>
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<td>West Bengal</td>
<td>16.2</td>
<td>5.7</td>
<td>4.2</td>
<td>26.1</td>
<td>58.05</td>
<td>28.34</td>
<td>18.74</td>
<td>105.13</td>
</tr>
<tr>
<td>India</td>
<td>17.6</td>
<td>5.18</td>
<td>2.85</td>
<td>25.63</td>
<td>52.68</td>
<td>18.79</td>
<td>0.96</td>
<td>72.43</td>
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</table>

Note: Figures in brackets denote the ratio of NPK

The imbalances in the fertilizer use are reflected in the deviation of NPK ratio from the recommended level of 4:2:1, which deteriorated the quality of soils. Imbalances in the fertilizers use were found in all the periods and in various states (Table 3.3).
The fertilizer consumption was 25.63 kg per hectare during 1970s and increased to 72.43 kg per hectare during 1990s. The fertilizer (NPK) consumption per hectare was higher 82.2 kg in Punjab and was lower 7.4 kg in Madhya Pradesh during 1970s. In Gujarat it was 27.6 kg in 1970s. In 1990s, the consumption of fertilizer per hectare was found higher 140.05 kg in Andra Pradesh and was lower 40 kg in Madhya Pradesh. There was, however, noticeable disparity in fertilizer use among the States during 1970s and 1980s and the variation has declined marginally during 1990s.

(c) Mechanization

Mechanization complements modern varieties to realise the production potential. Labour cost saving mechanical technologies with less drudgery and higher burden of maintenance of draught animals were the factors responsible for decline in use of animal labour. The rate of machine labour utilization per hectare has grown at the rate of 2.60 per cent per annum. Despite the decrease in use of human and animal labour, there was a rapid rise in wage rates for human and animal labour. Thus, the labour market is more distorted with more unequal distribution of total wages (Ramasamy C -2004).

(d) Rain fed Bias

In the rainfed areas, the productivity of crops are closely linked with the onset and extant of rainfall. Limited irrigation water will continue to be a major constraint for agricultural growth in rainfed areas. The absence of major development of input such as drought tolerant crop varieties and cultivation of crops in the marginal lands are responsible for poor productivity.

The past few decades have shown a secular rise in area under HYVs in rainfed and dry areas and has reached at a reasonable level. However, the productivities have been lower in dry areas as compared to irrigated areas due to poor adoption of associated technologies in the dry areas.
(3) RESOURCE CONSTRAINTS

(a) Marginalization of Holding

For the agricultural development, it is necessary to increase productivity of crops, employment generation and increase in income of the agricultural population. During the liberalization era over 40 per cent of the rural households became landless or near landless in India. Only about two-third of the owned land belonged to the marginal, small and semi-medium size groups (Ramasamy C. – 2004). The decades 1971-72 to 1991-92 witnessed a marked intensification of the marginalization process. Out of total cultivated area, the share of small farmers was 33.97 per cent which was higher in 1970-71. The small farmers became just doubled during the next two decades. The average size of holding decreased from 2.30 hectares in 1970-71 to 1.41 hectares in 1990-91 (Table 3.4). The number of operational holdings increased from about 70 million in 1970-71 to 106 million in 1990-91. This trend of magnification will continue in the future also.

Table 3.4:
Marginalization of Agricultural Holdings – Major States

<table>
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<td>Average Size</td>
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<td>Operational Holdings</td>
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</table>

Source: Fertilizer Statistics – 2004-05 and back issues

More than one-third land is owned and cultivated under small and marginal holdings and their share is increasing progressively. Nearly 50 per cent of land is cultivated in semi-medium or medium holdings and less than 15 per cent of land is
owned by large farmers and probably an even smaller area is operated by them (Vyas V.S.-2002 & Ranjana - 2005).

(b) Land Degradation

Natural resource degradation in rural areas is a serious concern. Sustainable management of land resources is to be set with two kinds of problems – managing the quantitative and the qualitative dimensions of land.

The quantitative dimension’s issues related to:

a. increasing human and animal population pressure on land and changes in the land use patterns, viz., decline in forest and fallow land.

b. erosion and loss of top soil which is very difficult to reverse.

The qualitative dimension relates to the loss of nutrients and the pollution of soil environment by agricultural and non agricultural activities.

There are large differences in the extent of land degradation due to various reasons. The estimates vary from about 36 million hectares to 188 million hectares (Ramasamy C.- 2004).

India’s total geographical area is 329 million hectares of which nearly 141 million hectares (about 43 per cent) is subject to water and soil erosion. In addition, nearly 34 million hectares is affected by other types of land degradation, i.e., water logging, alkaline and arid soils, salinity, and ravines and gullies etc. Thus, only 47 per cent of the land in the country can be considered pure. Incidence of land degradation is particularly severe in Rajasthan, Madha Pradesh and Maharashtra. Other seriously affected states are Andhra Pradesh, Gujarat, Karnataka and Uttar Pradesh. These seven states account for three forth of the area affected by soil and land degradation (Vyas V.S.-2002).

(c) Water Demand

There is a tremendous pressure on both qualitative and quantitative dimensions of water resources in the country. This is reflected in the sharp decline in the per capita availability of water by almost one-third over a period of last 50 years from 3107 cubic meter per year during 1951 to 1092 cubic meter per year in 2000 (Agricultural Statistics at a Glance- - 2002). Agriculture is not only a single largest
consumer of water, but also it is increasingly becoming a cause of water quality deterioration. The production of modern crop varieties, especially of rice and sugarcane, demand larger supply of water. Therefore, even though technological solution have the potential to solve the food problem, but are not sufficient to solve resource problems. Both equity and efficiency are the critical issues in water resource management given the highly uneven distribution of water resources across different regions of the country as well as the inequalities in access to irrigation water across farms within an area. Inequality in farm level access to irrigation water is another major problem as both surface water and groundwater.

Besides, due to the new agricultural technology the demand for irrigation water has increased significantly, which ultimately has resulted in exploitation of groundwater in many parts of India. The available groundwater has been steadily declining in most of the states. Further, exploitation of water through major and medium as well as minor irrigation sources form the states will certainly create adverse environmental problems (Verma H. M. and Bhaiya S.R.-2004).

(4) CAPITAL CONSTRAINTS

(a) Agricultural Investment

As a consequence of industrialization and the economic reforms, one could expect government expenditure on agriculture would suffer setbacks relative to other sectors. The progress of agricultural growth should be further augmented through price policies coupled with other non-price measures such as irrigation, infrastructure and research (Mellor J.W. and Ahmed R.-1988). India being primarily an agricultural economy, the due importance has been given to this sector over a period of time. However, there could be reduction in governments’ expenditure on agriculture consequent to industrialization and implementation of structural adjustment policies.

The percentage share of government expenditure on agriculture and allied activities has been declining during the globalization era. At present agriculture shares only 5.2 per cent of the total public outlay (Ramasamy C. - 2004). Falling real public investment in agriculture is a cause of major concern.
(1) Capital Formation

Without adequate investment agriculture cannot make substantial contribution to the economic development in the country. The share of agricultural sector in the domestic product is declining over the years because of relatively lower investment made by the public and private sectors. The growth of gross domestic formation has been slow particularly declines public capital formation in agriculture sector.

The capital formation in agriculture grew at the rate of 8.51 per cent during 1970s and declined at the rate of 0.33 per cent during 1980s and there was nominal increase during 1990s (1.99 per cent). Public capital formation in agriculture grew at higher rate of 9.5 per cent during 1970s but declined during 1980s and 1990s. This was mainly because a large proportion of the total resources ploughed into agriculture sector went to current expenditures on subsidies for fertilizers, irrigation, electricity, credit and other agricultural inputs (Mallick and et al – 1993). The share of agricultural capital formation in the gross capital formation also declined during the 1980s and 1990s.

During the post liberalization period, the improvement is found in foreign reserves, infrastructure like telecommunications and roads, information technology, stock market etc. But all such developments can be sustained in the long run, only if the growth in the agriculture sector too is accelerated (Ranjana – 2005). India continues to be predominantly an agrarian economy and without improvements and developments in this sector, the economy as a whole cannot expect to achieve and maintain a balanced and sustainable growth trend.

AGRICULTURAL CONSTRAINTS IN GUJARAT

Rice is the staple food in the country and in Gujarat; therefore, here an attempt is made to highlight some of major constraints of rice cultivation because that is directly linked with production and productivity of rice. These constraints also determine the economic conditions of the farmers. These constraints can be grouped in to four categories viz. (1) Natural Constraints, (2) Social constraints, (3) Research constraints and (4) General constraints.
(1) NATURAL CONSTRAINTS

(a) Poor Rainfall

In Gujarat overall position of rainfall is relatively poor. Net cultivated area covered under 1150 mm and above is 8 per cent only, under 750 to 1150 mm is 25 per cent and under below 750 mm is about 67 per cent which is larger in Gujarat. Even in good years, there is a gap between two spells of rainfall, sometimes exceeding one month or there is delayed rainfall or missing the last round of rains in September. The recurrent drought happens at least thrice in a decade. Sometimes there are two recurring droughts (Patel A.S. – 2006).

(b) Arid and Semi-arid Area

The proportion of arid (19.61 per cent) and semi arid (9.46 per cent) area in total net sown area is high.

(c) Salinity Problem in Districts

There is salinity ingress due to heavy withdrawal of groundwater and little recharge. This is happening in Banaskantha, Ahmedabad, Gandhinagar, Sabarkantha and Mehsana. Salinity in coastal areas is often due to underground faults in seacoast. This is affecting Bhavnagar, Junagadh, Amreli and Kutch. There are areas along the periphery of little and great rann of Kutch, particularly of Banaskantha and Surendranagar districts, which are affected by the advancement of rann.

(d) Drought Prone Districts

There are 11 drought prone districts in the state. The drought prone area covered about 29 per cent of the total area. About 18 per cent of the total population lives in these districts (Patel A.S. – 2004).

(e) High Salinity and Water Logging

Area adversely influenced by salinity and water logging constituted 21.80 and 16.52 per cent of irrigated area respectively in Gujarat, while the corresponding figures were 9.37 per cent and 9.67 per cent of irrigation utilization respectively at the nation level (Patel A.S. – 2006).
(f) Irrigation Potential

The irrigation potential capacities are lower in Gujarat as compared to the national level. Besides, the utilization from the available irrigation potential is weak in Gujarat as compared to the national level.

(2) SOCIAL CONSTRAINTS

a) High growth of population
b) Increased fragmentation of landholding
c) Low level of female literacy in many districts like Banaskantha, Panchmahals, Dangs etc. (below 40 per cent), level of female literacy in many districts viz. Kutch, Sabarkantha, Surendranagar, Jamnagar, Junagadh, Amreli, Bhavnagar was between 40 to 50 per cent.
d) Low social status of women and low sex ratio
e) A high percentage of population belongs to schedule tribes (near 15 per cent – 2001) and schedule caste (7 per cent – 2001) and majority of them live in rural areas and are below poverty line. They are also unable to absorb new technology and take risk.

(3) RESEARCH CONSTRAINTS

a) Research based improvements are not made in seeds of various crops.
b) Limited expertise available for research in agro-forestry, horticulture-floriculture and fodder crops.
c) Limited knowledge and literature available for post-harvest management activates for the corps.
d) Limited research facility in biotechnology.
e) Little information on cropping system based agriculture for various agro-climatic conditions.
f) Very few research in organic farming
g) Package of practices for integrated pest management not available for many crops.
h) The research on efficient use of water saving devices like sprinklers, drip irrigation are lacking.
i) Lake of effective strategy for management of vast and semi arid soils.
(4) GENERAL CONSTRAINTS

(a) Pressure of population on Land

Increased pressure of population on land has resulted in fall in average operational holding from 4.11 hectares in 1970-71 to 2.93 hectares in 1990-91 and 2.62 hectares in 1995-96 in Gujarat. The share of marginal and small holders was 52.29 per cent and its share in total operated area was 17.79 per cent (Statistical Abstract – 2001).

(b) Fertilizer Use

Average fertilizer used was very low per hectare in Gujarat (only 0.85 kg NPK in 1960-61) as against of India (2 kg NPK). It was 71 kg NPK per hectare in Gujarat which was lower than the India (87 kg) in 2000-01. Due to poor rainfall situation and frequent draughts in Gujarat the use of fertilizer was adversely affected.

(c) Constraint of Irrigation

Though agricultural resource base and natural forces are relatively less favorable in Gujarat as against to India from the point of view of growth performance the former has showed a fairly good performance, compared to many states of India. Gujarat is relatively poor in respect of both groundwater and surface water resources in comparison to all India position (Patel A.S.-1997). The water resources of Gujarat, even after considering allocated share from the inter-state rivers, are hardly 2 per cent of the country’s total water resources. Therefore, the per capita availability of water in Gujarat is only 40 per cent of the India’s average (Patel C.C. -2001). Moreover, inter district disparity in the availability of irrigation water is very high (Patel Arun- 1993).

CONSTRAINTS OF RICE CULTIVATION/PRODUCTION

In India as well as in Gujarat, various studies have been carried out which highlight major problems related to cultivation of rice. A bird view overview of these studies has been presented in the subsequent paragraph:

It has been reported that in spite of the absence of supply side bottlenecks, the cultivators have not accepted the modern rice technologies as per recommendation. (Kalirajan – 1980, Marothia – 1983, Rai 1985, Silier – 1980).
For irrigated, with high yielding variety of paddy, the cost of inputs was perceived to be most important (Singh K M and Singh R K P – 2001).

Due to structural constraints like scarcity of enough sweet water for irrigation and less rainfall the productivity has fallen (Jain K K – 1993).

The increase in yield of rice was not uniform during 1961-64 and 1980-83 and large variations had been experienced in the use of resources, especially of the irrigated area devoted to rice cultivation use of HYVs, application of chemical fertilizer (Pandey R K and Sarup Shanti – 1989).

On an average, there is greater yield of HYVs of rice than the traditional rice in cultivation. But HYVs have greater risk as measured by yield variance (Saha Anamotra – 2001). There are many constraints are effected the rice cultivation in rice cultivated areas. The socio-economic and infrastructure constraints are (a) Lake of adequate capital / institutional credit (b) Poverty and indebtedness of subsistence farmers (c) High incidence of unrecorded tenancy (d) Fragmentation of holding (e) Breakdown of participatory (f) Collective approach to irrigation water management (g) Non-availability of quality seed and other inputs (h) Inadequate access to irrigation, market and extension. Therefore, different strategies needed to solve the problems of rice-cultivated areas (Chaand Ramesh and et al - 1998).

The farmers, due to lake of staying power and absence of government procuring agencies, were forced to sell their produce at a much lower price in the market (Atibudhi H. N.).

Higher cost of hybrid rice seed was serious constraints that led to discontinuance of hybrid rice cultivation in India (Janaiah Aldus and Hossain Mahabub – 2003).
SECTION - II

Major Paddy Cultivation Problems
Yield Gap in Paddy

India is still among the countries with the lowest rice yields. 70 per cent of the 414 rice growing districts report yields lower than the national average, clearly indicating that well after the advent of high yielding technology, a sizable area is categorized as low producing. Sixty per cent of the low productivity rice areas are in Bihar, Orrisa, Assam, West Bengal and Uttar Pradesh. Moreover, 32 per cent of the irrigated rice areas produce low yields. Yield gap analysis further reveals that 30 to 40 per cent of the potential yield is yet to be tapped with the available high yielding varieties sown on highly productive irrigated soils (Ramasamy C. - 2004). After a long period of technological breakthroughs and adoption, yield gap still exists in many states (Table 3.5).

Table 3.5:

Yield Gap in Paddy in Major Rice Growing States (1990-91 to 1997-98)

<table>
<thead>
<tr>
<th>State</th>
<th>State Average</th>
<th>Experimental plot Average</th>
<th>Yield Difference</th>
<th>Gap: State Average vs. Experimental Average (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gap: Above 50 per cent</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rajasthan</td>
<td>1582</td>
<td>6485</td>
<td>4903</td>
<td>75.60</td>
</tr>
<tr>
<td>Bihar</td>
<td>1811</td>
<td>6083</td>
<td>4272</td>
<td>70.20</td>
</tr>
<tr>
<td>Assam</td>
<td>1954</td>
<td>6437</td>
<td>4483</td>
<td>69.60</td>
</tr>
<tr>
<td>Madha Pradesh</td>
<td>1581</td>
<td>4710</td>
<td>3129</td>
<td>66.40</td>
</tr>
<tr>
<td>Orrisa</td>
<td>993</td>
<td>5620</td>
<td>3627</td>
<td>64.50</td>
</tr>
<tr>
<td>Gujrat</td>
<td>2146</td>
<td>5557</td>
<td>3411</td>
<td>64.10</td>
</tr>
<tr>
<td>Jammu &amp; Kashmir</td>
<td>2774</td>
<td>7254</td>
<td>4480</td>
<td>61.80</td>
</tr>
<tr>
<td>Himachal Pradesh</td>
<td>1976</td>
<td>5003</td>
<td>3027</td>
<td>60.50</td>
</tr>
<tr>
<td>Manipur</td>
<td>3233</td>
<td>7619</td>
<td>4386</td>
<td>57.30</td>
</tr>
<tr>
<td>Uttar Pradesh</td>
<td>2870</td>
<td>6598</td>
<td>3728</td>
<td>56.50</td>
</tr>
<tr>
<td><strong>Gap: Below 50 per cent</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kerala</td>
<td>2857</td>
<td>5690</td>
<td>2853</td>
<td>49.80</td>
</tr>
<tr>
<td>Haryana</td>
<td>4074</td>
<td>7396</td>
<td>3322</td>
<td>44.90</td>
</tr>
<tr>
<td>West Bengal</td>
<td>3147</td>
<td>5003</td>
<td>1856</td>
<td>37.10</td>
</tr>
<tr>
<td>Andhra Pradesh</td>
<td>3767</td>
<td>5882</td>
<td>2115</td>
<td>36.00</td>
</tr>
<tr>
<td>Karnataka</td>
<td>3456</td>
<td>5250</td>
<td>1794</td>
<td>34.20</td>
</tr>
<tr>
<td>Punjab</td>
<td>5042</td>
<td>6460</td>
<td>1418</td>
<td>22.00</td>
</tr>
<tr>
<td>Tamil Nadu</td>
<td>4460</td>
<td>5286</td>
<td>826</td>
<td>15.60</td>
</tr>
<tr>
<td>India</td>
<td>2759</td>
<td>5781</td>
<td>3022</td>
<td>52.30</td>
</tr>
</tbody>
</table>

Source: Siddiq (2000)
The table shows that there was noticeable gap found in states during 1990-91 to 1997-98. The gap was more than 50 per cent i.e. 56.50 per cent to 75 per cent between state average yield and experimental average yield of rice in many states of the country. The yield gap was less than 50 per cent i.e. about 16 per cent to 49 per cent between state average yield and experimental average yield of rice in many states.

**Low level Yield of Rice**

Despite of being an ‘agriculturally advanced’ state the yield of rice found lower than the national average expect 1970-71 year. The yield figures for rice for the different periods in Gujarat and All India have been presented in Table 3.6.

**Table 3.6:**

**Yield of Rice in Gujarat and India**

(Yield in Kg./Hect.)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Gujarat</td>
<td>1223</td>
<td>1165</td>
<td>1490</td>
<td>1891</td>
</tr>
<tr>
<td>2</td>
<td>India</td>
<td>1123</td>
<td>1336</td>
<td>1740</td>
<td>2077</td>
</tr>
<tr>
<td>3</td>
<td>Gujarat as per cent of all India</td>
<td>108.90</td>
<td>87.20</td>
<td>85.63</td>
<td>91.04</td>
</tr>
</tbody>
</table>

Source: Agricultural Statistics at a Glance, Ministry of Agriculture, GOI

**Graph 3**

![Graph showing yield of rice in Gujarat and India](image)

The table 3.7 depicts a comparison of the yield of rice in Gujarat with that of other states for the various periods has been presented.
The table reveals that rice yield in Gujarat was 55.40 per cent below than that of Bihar, which is a backward state with massive illiteracy. Also their yield is much below than that of other leading states like Punjab, Tamil Nadu, Haryana, Karnataka and Andhra Pradesh. Thus, even through 90 per cent of rice grown in high yielding varieties, it appears that adequate attention has not been paid to improve yields. Besides, Punjab and Haryana both are not major rice consuming states, but they decided to cultivate Basmati rice for value addition as they saw opportunity. Gujarat also produces Surti Kolam, which is well accepted. Yet, value addition does not seem to have received the derived attention, even within the limitation of the soil conditions (Agro Vision: 2010 - 2000).

Table 3.7:
State wise Yield of Rice per Hectare in different Periods

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>State</th>
<th>Yield 1970-71</th>
<th>Yield 2003-04</th>
<th>Gujarat Rice Yield as Percent of other States</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>West Bengal</td>
<td>1239</td>
<td>2504</td>
<td>98.71</td>
</tr>
<tr>
<td>2</td>
<td>Bihar</td>
<td>787</td>
<td>1566</td>
<td>155.40</td>
</tr>
<tr>
<td>3</td>
<td>Orissa</td>
<td>962</td>
<td>1511</td>
<td>127.13</td>
</tr>
<tr>
<td>4</td>
<td>Andhra Pradesh</td>
<td>1359</td>
<td>3009</td>
<td>89.99</td>
</tr>
<tr>
<td>5</td>
<td>Punjab</td>
<td>1764</td>
<td>3694</td>
<td>69.33</td>
</tr>
<tr>
<td>6</td>
<td>Tamil Nadu</td>
<td>1974</td>
<td>2523</td>
<td>61.96</td>
</tr>
<tr>
<td>7</td>
<td>Maharashtra</td>
<td>1226</td>
<td>1850</td>
<td>99.76</td>
</tr>
<tr>
<td>8</td>
<td>Karnataka</td>
<td>1684</td>
<td>2190</td>
<td>72.62</td>
</tr>
<tr>
<td>9</td>
<td>Haryana</td>
<td>1710</td>
<td>2749</td>
<td>71.52</td>
</tr>
<tr>
<td>10</td>
<td>Gujarat</td>
<td>1223</td>
<td>1891</td>
<td>100.00</td>
</tr>
<tr>
<td>11</td>
<td>Kerala</td>
<td>1483</td>
<td>2141</td>
<td>82.47</td>
</tr>
<tr>
<td>12</td>
<td>Other States</td>
<td>1229</td>
<td>1699</td>
<td>99.51</td>
</tr>
<tr>
<td></td>
<td>India</td>
<td>1123</td>
<td>2077</td>
<td>108.90</td>
</tr>
</tbody>
</table>

Source: Agricultural Statistics at a Glance, Ministry of Agriculture, GOI

Stagnant Area under Rice

The table 3.8 indicates the area under rice in Gujarat, Haryana and Punjab. In 1970-71, Gujarat had higher area under cultivation of rice (489000 hectares) than Punjab (390000 hectares) and Haryana (269000 hectares). However, by 2003-04, in Gujarat, area under rice cultivation had reached to 675000 hectares (Table 3.9), a growth of 38.04 per cent, whereas, in Punjab area under cultivation of rice increased to 2614000 hectares (a growth of 570.26 per cent) and in Haryana to 1016000 hectares (a growth of 277.70 per cent).
Table 3.8:
Area under Rice in Punjab, Haryana and Gujarat
(Area in '000 Hectare)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Punjab</td>
<td>390</td>
<td>1178</td>
<td>2024</td>
<td>2614</td>
</tr>
<tr>
<td>2</td>
<td>Haryana</td>
<td>269</td>
<td>472</td>
<td>661</td>
<td>1016</td>
</tr>
<tr>
<td>3</td>
<td>Gujarat</td>
<td>489</td>
<td>478</td>
<td>531</td>
<td>675</td>
</tr>
<tr>
<td></td>
<td>India</td>
<td>37592</td>
<td>40152</td>
<td>42687</td>
<td>42496</td>
</tr>
</tbody>
</table>

Source: Ministry of Agriculture, GOI.

Benefit Cost Ratio of Rice Declines

The surplus production of rice could not be exported profitably as the ruling price in the international markets was not affordable. Consequently with mounting stocks, the prices of commodities in the domestic market fell far below the cost of production. In case of paddy a proportionate increase in the cost of production was more than the increase in income and as a result, the benefit cost ratio declined (Ramasamy - 2004).

RICE CULTIVATION PROBLEMS IN GUJRAT

The share of non-food grain crops in GCA has increased from nearly 53 per cent to 60 per cent during the study period. The share of cereal was about 42 per cent of GCA in 1970-75, which has declined to 32 per cent in 1998-03. (Patel A.S – 2006). But, the area under rice has gradually increased over the study period. The percentage share of area under rice was about 10.42 per cent to total cereal’s area in 1970-75 and it has significantly increased to 21.89 per cent to total cereal’s area in 2000-05. The area under rice was about 9.48 per cent to total food grain’s area in 1970-75 and it has also increased to 17.43 per cent to total food grain:’s area in 2000-05. However, there are many rice cultivation problems in Gujarat at the district level. Some major problems are discussed below.

RICE CULTIVATION PROBLEMS

(1) Low Productivity Level of Rice

It is observed that the overall growth performance of agriculture in Gujarat is poor. Hence poor productivity performance in respect of paddy in Gujarat may be a part of the general trend observed in the state. What is observed at the state level is also found to be true at the district level. At the district level, out of 11 major rice
growing districts, where paddy is grown only in 5 districts the yield rates have shown noticeable change.

The variations in yield rates indicate a minimum estimate of 609 kg for Panchmahals and maximum figure of 1186 kg for Vasad in the 1970-75. For the period 2000-05, the variation is from 524 kg for Panchmahals to 2363 kg for Gandhinagar. The figure of C.V. worked out to 9.31 per cent in 1970-80 and 14.19 per cent in 2000-05, indicating thereby a rise in disparity of yield at the district level in Gujarat.

(2) Price of Paddy

For the paddy crop, cost of cultivation is varying considerably not only from one district to other district, but also among the farmers of the same village. Owing to difference in the technology applied, land productivity and inputs use pattern. The MSP declared for each crop is uniform for all the states of India. Due to large variation in cost of production of crops from state to state, district to district and farmer to farmer, it is obvious that declared MSP cannot ensure cost plus situation for all farmers.

There was wide variation in the yield level of paddy, high inter district variation of cost of production. Cost of production of paddy was Rs. 510 per quintal in Sabarkantha, whereas it was Rs. 630 in Panchmahals district in 2000-01 agriculture year. The MSP declared for paddy was Rs. 510 per quintal. A comparison of cost of paddy and MSP clearly suggest that declared MSP was not favorable to paddy growers of the state (Shah V. D. and Patel H. F. - 2003).

(3) Use of HYV Seeds of Paddy and Productivity

According to Gujarat Agro vision 2010, a working document, yield of rice was static during 1988-89 to 1997-98. The yield was 20 per cent lower than the nation average. However, almost 90 per cent area was under HYV. The yield figures for rice for the 10 years ranging form 1988-89 to 1997-98 in Gujarat and all India is given in Table 3.9
In can be seems from the table that the yield of rice for Gujarat was less as compared to all India during the mentioned period. During this period the yield was less at 85.63 per cent in 1991-92 and 95.86 per cent in 1988-89. Thus, low yield of rice is the major issue for the state of Gujarat.

Table 3.9:
Yield for Rice

<table>
<thead>
<tr>
<th>Year</th>
<th>Yield (Kg per Hectare)</th>
<th>Gujarat as % of All India</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Gujarat</td>
</tr>
<tr>
<td>1988-89</td>
<td>1620</td>
<td>1690</td>
</tr>
<tr>
<td>1989-90</td>
<td>1360</td>
<td>1740</td>
</tr>
<tr>
<td>1990-91</td>
<td>1490</td>
<td>1740</td>
</tr>
<tr>
<td>1991-92</td>
<td>1150</td>
<td>1750</td>
</tr>
<tr>
<td>1992-93</td>
<td>1460</td>
<td>1740</td>
</tr>
<tr>
<td>1994-95</td>
<td>1400</td>
<td>1896</td>
</tr>
<tr>
<td>1995-96</td>
<td>1450</td>
<td>1800</td>
</tr>
<tr>
<td>1996-97</td>
<td>1470</td>
<td>1882</td>
</tr>
<tr>
<td>1997-98</td>
<td>1550</td>
<td>1895</td>
</tr>
</tbody>
</table>

Source: CMIE

(4) Extension Activities

An agricultural education and extension activity plays an important role in developing agricultural human resources and transfer of knowledge from the laboratory to the field. These services act as a support in the adoption process by the farmers by providing inputs at every stage of the farming practices till it results economic surplus. In Gujarat Agriculture University has been established with the aim of developing new production technologies in agriculture and allied fields and organizing extension programmes for transfer of new technologies in the benefit of rural masses. However, there is a lack of regularity in visits made by the extension personal in their area. Therefore, the system of extension activities and services have remained very poor and ultimate objective of growth and development is not achieved satisfactory (Gujarat Agro vision – 2000). This situation and attitude toward these services of the farmers has effects the farming practices, which also inversely affects the paddy cultivation, because this crop have higher disease during the maturity.
Area under rice has not shown any significant changes. Rice is mainly rain fed crop. Alluvial soils and heavy rainfall or availability of irrigation are the two dominant favorable factors for the geographical distribution of rice in Gujarat.

Out of total 11 major rice growing districts in the state, Dangs and Valsad districts have deep black with few patches of coastal alluvial laterite soil, Vadodara, Kheda, Panchmahals districts have medium black to goradu and alluvial sandy loam to sandy clay loam, Ahmedabad, Gandhinagar, Sabarkantha, Mehsana districts have alluvial sandy to sandy loam. Bharuch and Surat districts have heavy black clayey soil (Dutta Rajeshree A – 1993). Thus, soil variation is effects the yield of paddy.

During the study period, the irrigated area has increased remarkably in Kheda, Gandhinagar, Mehsana and Surat district only while it has increased gradually in the remaining districts (Table 3.10). The paddy crop is the most irrigated crop and lake of sufficient development of irrigation in the paddy growing district results in the stagnation in the area under rice cultivation.

<table>
<thead>
<tr>
<th>District</th>
<th>Percentage share of Irrigated area to GCA</th>
</tr>
</thead>
<tbody>
<tr>
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<td>18.60</td>
</tr>
<tr>
<td>Gujarat</td>
<td>15.14</td>
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</table>

(6) **Agro-climatic related Problems**

Water logging and salinity are major constraints in the major rice growing districts such as Surat, Bharuch, Valsad and Dangs districts. The groundwater potential inadequately tapped in these districts. In these districts, there are large tribal populations and they grow inferior cereals crops. The large area prone to soil erosion is in Vadodara, Kheda and Panchmahals due to undulating terrain depleting soil fertility and crop productivity. Some pockets suffer from water logging and soil salinity problems in these districts. The inherent salinity in large areas is in Ahmedabad, Gandhinagar, Mehsana and Sabarkantha districts (Dutta Rajeshree A – 1993).

1. **Arid land** - The districts included in this type of land are Mehsana and Sabarkantha. These districts are suffering from inadequate and erratic rainfall.

2. **Semi Arid land** – Gandhinagar, Ahmedabad, Kheda, Panchmahals and Vadodara districts would be included in this category. Soil salinity in this region is caused by weathering of the marine sedimentary rocks. Due to salinity of soil problem, some part of these districts agricultural land has lost its productivity considerably.

Thus, various agro climatic problems has been effected the rice cultivation and its productivity.
SECTION – III

Variability in Productivity of Rice in Gujarat
In India, as well as in Gujarat, the new farm seed, fertilizer and technology were introduced around mid 60s. With the expansion of irrigation facility, increase in use of modern agricultural inputs, the instability in yield should be lower after 60s especially in 70s, 80s and 90s. (Dutta R.A.-1994) The nature of variability in productivity per hectare over time is worth inquiring. In order to inquire in to this aspect the estimates of co-efficient of variations (C.V.) were carried separately for the various decades. The co-efficient of variations (C.V.) indicates the disparities or inequality among the districts. In this context, an attempt is made here to examine the extent of variability in the yield of rice in different districts of the state. The variability of yield of rice is examined by the co-efficient of variance (C.V.) for the various decades i.e. 1971-80-first period, 1981-90-second period, 1991-2000-thired period and 2001-05-fourth period. The variability in the yield of total rice, kharif rice, summer rice, irrigated rice and unirrigated rice have been presented in tables 3.9 to.3.11

Productivity of Rice

The table 3.11 shows that C.V. of rice productivity decreased in the second period as compared to first period but there was further a marginal increase in the state. During the first to third period, C.V. continuously decreased for Ahmedabad, Vadodara, Bharuch, Gandhinagar, Kheda and Mehsana districts, whereas; the C.V. increased in Valsad, Sabarkantha, Banaskantha, Bhavnagar and Jamnagar districts.

It may be noted here that C.V. has shown a low, the extent of low are found to be considered as significant for Ahmedabad, Gandhinagar, Mehsana districts while that has been observed to be significantly high for Banaskantha, Bhavnagar, Jamnagar, and Rajkot districts during same periods.
Table 3.11:
Nature of Variability (Co-efficient of Variation - C.V. in per cent) in productivity growth of Total Rice

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<td>14.19</td>
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</tbody>
</table>

Source: Worked out on the basis of the data available in the Directorate of Agriculture, Krushi Bhavan, Government of Gujarat, Gandhinagar

For the forth period, C.V. has been observed to significantly high for all districts except Vadodara, Bharuch, Surat, Dangs and Panchmahals.

Productivity of Kharif Rice

It can be observed from table 3.12 that among the main rice-growing districts in the kharif season, C.V. continuously declined in all districts.
Table 3.12:
Nature of Variability (Co-efficient of Variation - C.V. in per cent) in productivity growth of Kharif Rice

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<td>4.72</td>
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<td>38.57</td>
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<td>71.03</td>
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<td>4.03</td>
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<td>9.31</td>
<td>4.03</td>
<td>4.90</td>
<td>14.32</td>
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</tbody>
</table>

Source: Worked on the basis of the data available in the Directorate of Agriculture, Krushi Bhavan, Government of Gujarat, Gandhinagar

The extent of decrease are found to be considered as significant for Ahmedabad, Bharuch, Kheda, Mehsana and Panchmahals districts as well as the state during the last three decades. This had increased for Sabarkantha and Surat districts but was significantly high for Sabarkantha.

For the fourth period, C.V. has been observed to be significantly high for all districts except Vadodara, Bharuch, Surat, Dangs and Panchmahals.

**Productivity of Summer Rice**

The data regarding the Variability in productivity of summer rice are presented in Table 3.13. During the second to third period, C.V. significantly decreased in all summer rice producing districts except Valsad. For the state as whole,
C.V. was marginally high in second period. While in forth period, C.V. was found to be very high for all districts except Valsad and Surat.

**Table 3.13: Nature of Variability (Co-efficient of Variation - C.V. in per cent) in productivity growth of Summer Rice**

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Source: Worked on the basis of the data available in the Directorate of Agriculture, Krushi Bhavan, Government of Gujarat, Gandhinagar

**Productivity of Irrigated Rice**

The table 3.14 shows that C.V. of rice productivity of irrigated area under rice. The C.V. of this yield was marginally declined in second period but increased marginally in the third period while it significantly increased in the forth period. Among the main rice-growing district area under irrigated rice, the C.V. of yield of irrigated area continuously declined in Ahmedabad, Vadodara, Valsad, Gandhinagar and Mehsana. Among the major rice producing districts, Surat had higher and Kheda had lower C.V.

For the fourth period, C.V. was observed to significantly lower in Bharuch and Surat districts while high in all districts except Bharuch, Surat and Dangs.
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<td>Source:</td>
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**Productivity of Unirrigated Rice**

The Table 3.15 shows that the C.V. of yield of unirrigated area increased in almost all major rice growing districts in 1990-91 to 1999-2000 periods as against 1970-71 to 1979-80 but it declined in the state as a whole. In fourth period (2000-01 to 2004-05) it was significantly higher in Ahmedabad, Valsad, Gandhinagar, Kheda, Mehsana, Sabarkantha and Surat.
Table 3.15:
Nature of Variability (Co-efficient of Variation - C.V. in per cent) in productivity growth of Unirrigated Rice

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Source: Worked on the basis of the data available in the Directorate of Agriculture, Krushi Bhavan, Government of Gujarat, Gandhinagar

Highest and Lowest Yield Levels

The variation of yield of rice has been presented in this section and an attempt is made to judge the nature of variability through the data of maximum and minimum levels of yield of rice per hectare. The various period wise data are presented in Table nos. 3.16 to 3.18.

Generally, with the economic and agricultural development, the yield of crops are expected to go up, further the variance of yield is expected to go down. The absence of such expected trend with fluctuating yield of rice is considered as an indication of instability.

During 1970-71 to 1974-75 yield of rice per hectare found maximum 1234 kg and minimum 526 kg in Gujarat. The variation was about 57 per cent (708 kg) during this period. Among the major rice growing districts the maximum yield was 1575 kg in Kheda and minimum was 20 kg in Panchmahals during the 1970-71 to 1974-75. The high variation observed in Panchmahals (97.88) and low variation observed in Surat district (41.54 per cent).

The yield of rice per hectare was found minimum 1519 kg and minimum 1003 kg in Gujarat during 1980-81 to 1984-85. The variation was 516 kg (33.94 per cent) during this period. The higher yield per hectare obtained (1947 kg) again in Kheda and lower obtained (300 kg) in Bhruch district. Panchmahals district registered higher variation about 81 per cent and lower in Mehsana only 16.36 per cent.

For the state as whole, the yield of rice per hectare was found minimum 1590 kg and minimum 1211 kg in Gujarat during 1990-91 to 1994-95. The variation was 378 kg (28.8 per cent) during this period. The higher yield per hectare obtained 2480 kg for Gandhinagar and lower obtained 242 kg for Panchmahals district. Panchmahals district registered higher variation 74.55 per cent and lower in Surat only 10.82 per cent.

During 2000-01 to 2004-05, the yield of rice per hectare was found minimum 2010 kg and minimum 896 kg in Gujarat. The variation was 1115 kg (55.45 per cent) during this period. The higher yield per hectare obtained 4214 kg for Valsad and lower obtained only 66 kg for Panchmahals district again. The higher variation was found again in Panchmahals district (94.49 per cent) and lower in Surat (16.90 per cent).
Table: 3.16
District wise Maximum and Minimum Yield of Total Rice during Study Period
(Yield Kg/Hect.)

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Source: Worked on the basis of the data available in the Directorate of Agriculture, Krushi Bhavan, Government of Gujarat, Gandhinagar
Max: Maximum and Min: Minimum

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Table: 3.16 Cont...
District wise Maximum and Minimum Yield of Total Rice during Study Period
(Yield Kg/Hect.)

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Source: Worked on the basis of the data available in the Directorate of Agriculture, Krushi Bhavan, Government of Gujarat, Gandhinagar
Max: Maximum and Min: Minimum


During 1970-71 to 1974-75 yield of rice per hectare found maximum 1234 kg and minimum 526 kg in Gujarat. The variation was about 57 pre cent (708 kg.) during this period. Among the major rice growing districts the maximum yield was 1575 kg in Kheda and minimum was 20 kg in Panchmahals during the 1970-71 to 1974-75. The high variation observed in Panchmahals (97.88) and low variation observed in Surat district (41.54 per cent).
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Source: Worked on the basis of the data available in the Directorate of Agriculture, Krushi Bhavan, Government of Gujarat, Gandhinagar
Max: Maximum and Min: Minimum

Cont....
Table: 3.17 Cont...

District wise Maximum and Minimum Yield of Kharif Rice during Study Period
(Yield Kg/Hect.)

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<td>1895</td>
</tr>
<tr>
<td>5</td>
<td>Dangs</td>
<td>1341</td>
<td>651</td>
</tr>
<tr>
<td>6</td>
<td>Gandhinagar</td>
<td>2480</td>
<td>1764</td>
</tr>
<tr>
<td>7</td>
<td>Kheda</td>
<td>1937</td>
<td>1397</td>
</tr>
<tr>
<td>8</td>
<td>Mehsana</td>
<td>2181</td>
<td>815</td>
</tr>
<tr>
<td>9</td>
<td>Panchmahals</td>
<td>941</td>
<td>242</td>
</tr>
<tr>
<td>10</td>
<td>Sabarkantha</td>
<td>1756</td>
<td>685</td>
</tr>
<tr>
<td>11</td>
<td>Surat</td>
<td>1921</td>
<td>1760</td>
</tr>
</tbody>
</table>

Other Rice Producing Districts

| 12      | Banaskantha | 2000 | 1500 | 500    | 25.00 | -    | -    | -     | -     |
| 13      | Amreli      | -    | -    | -     | -     | -    | -    | -     | -     |
| 14      | Bhavnagar   | -    | -    | -     | -     | -    | -    | -     | -     |
| 15      | Jamnagar    | -    | -    | -     | -     | -    | -    | -     | -     |
| 16      | Junagadh    | 2000 | 1600 | 400    | 20.00 | -    | -    | -     | -     |
| 17      | Kutch       | -    | -    | -     | -     | -    | -    | -     | -     |
| 18      | Rajkot      | -    | -    | -     | -     | -    | -    | -     | -     |
| 19      | Surendranagar | 2000 | 1600 | 400    | 20.00 | -    | -    | -     | -     |
| 20      | Gujarat     | 1537 | 1151 | 386    | 25.12 | 1952 | 851  | 1100   | 56.38 |

Source: Worked on the basis of the data available in the Directorate of Agriculture, Krushi Bhavan, Government of Gujarat, Gandhinagar

Max: Maximum and Min: Minimum

The yield of rice per hectare was found maximum 1501 kg and minimum 980 kg in Gujarat during 1980-81 to 1984-85. The variation was 521 kg (34.68 per cent) during this period. The higher yield per hectare obtained (2216 kg) in Valsad and lower obtained (422 kg) in Vadodara district. Panchmahals district registered higher variation about 81 per cent and lower in Mehsana only 16.36 per cent.

For the state as whole, the yield of rice per hectare was found maximum 1537 kg and minimum 1151 kg in Gujarat during 1990-91 to 1994-95. The variation was 386 kg (25.12 per cent) during this period. The higher yield per hectare obtained 2480 kg for Gandhinagar and lower obtained 242 kg for Panchmahals district. Panchmahals district registered higher variation 74.26 per cent and lower in Surat only 8.37 per cent.
During 2000-01 to 2004-05, the yield of rice per hectare was found maximum 1952 kg and minimum 851 kg in Gujarat. The variation was 1100 kg (56.38 per cent) during this period. The higher yield per hectare obtained 4275 kg for Valsad and lower obtained only 66 kg for Panchmahals district again. The higher variation was found again in Panchmahals district (94.47 per cent) and lower in Surat (14.16 per cent).

The maximum and minimum per hectare yield of rice in summer season during the periods 1970-70 to 1974-75, 1980-81 to 1984-85, 1990-91 to 1994-95 and 2000-01 to 2004-05 given in Table 3.18.

During 1980-81 to 1984-85 yield of rice per hectare found maximum 4367 kg and minimum 2950 kg in Gujarat. The variation was about 32 pre cent (1417 kg.) during this period. Among the major rice growing districts the maximum yield was 4492 kg in Valsad and minimum was 2167 kg in Surat. The higher variation observed in Surat (4277).

The yield of rice per hectare was found maximum 4571 kg and minimum 3043 kg in Gujarat during 1990-91 to 1994-95. The variation was 1528 kg (33 pre cent) during this period. The higher yield per hectare obtained again (5500 kg) in Valsad and lower obtained (2537 kg) in Kheda district.

The yield of rice per hectare was found maximum 4636 kg and minimum 2841 kg in Gujarat during 2000-01 to 2004-2005. The variation was 1795 kg (39 pre cent) during this period. The higher and lower yield per hectare obtained in Surat 4824 kg and 2228 kg.
Table 4.14:
Variety of Paddy Growing by the Sample Farmers

<table>
<thead>
<tr>
<th>Crop</th>
<th>Variety of Paddy</th>
<th>Marginal</th>
<th></th>
<th>Small</th>
<th></th>
<th>Medium</th>
<th></th>
<th>Large</th>
<th></th>
<th>All Farms</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Area</td>
<td>%</td>
<td>Area</td>
<td>%</td>
<td>Area</td>
<td>%</td>
<td>Area</td>
<td>%</td>
<td>Area</td>
<td>%</td>
</tr>
<tr>
<td>Kharif Paddy</td>
<td>Gujarati</td>
<td>15.02</td>
<td>36.63</td>
<td>35.50</td>
<td>39.60</td>
<td>57.30</td>
<td>54.99</td>
<td>113.76</td>
<td>36.04</td>
<td>221.58</td>
<td>37.25</td>
</tr>
<tr>
<td></td>
<td>Gujarat-17</td>
<td>0.96</td>
<td>2.34</td>
<td>1.44</td>
<td>1.61</td>
<td>0.00</td>
<td>0.00</td>
<td>12.24</td>
<td>3.88</td>
<td>14.64</td>
<td>2.46</td>
</tr>
<tr>
<td></td>
<td>Jaya-2</td>
<td>1.08</td>
<td>2.63</td>
<td>0.00</td>
<td>0.00</td>
<td>6.00</td>
<td>4.04</td>
<td>0.00</td>
<td>0.00</td>
<td>7.08</td>
<td>1.19</td>
</tr>
<tr>
<td></td>
<td>Masuri-Butt</td>
<td>0.24</td>
<td>0.59</td>
<td>0.00</td>
<td>0.00</td>
<td>2.16</td>
<td>1.45</td>
<td>11.10</td>
<td>3.52</td>
<td>13.50</td>
<td>2.27</td>
</tr>
<tr>
<td></td>
<td>Moti</td>
<td>2.46</td>
<td>6.00</td>
<td>4.82</td>
<td>5.38</td>
<td>3.00</td>
<td>2.02</td>
<td>4.92</td>
<td>1.56</td>
<td>15.20</td>
<td>2.56</td>
</tr>
<tr>
<td></td>
<td>Rupali</td>
<td>0.00</td>
<td>0.00</td>
<td>0.24</td>
<td>0.27</td>
<td>1.44</td>
<td>0.97</td>
<td>0.00</td>
<td>0.00</td>
<td>1.68</td>
<td>0.28</td>
</tr>
<tr>
<td></td>
<td>Centerd</td>
<td>0.00</td>
<td>0.00</td>
<td>0.72</td>
<td>0.80</td>
<td>2.40</td>
<td>1.62</td>
<td>4.32</td>
<td>1.37</td>
<td>7.44</td>
<td>1.25</td>
</tr>
<tr>
<td></td>
<td>Adventa</td>
<td>0.60</td>
<td>1.46</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.60</td>
<td>0.10</td>
</tr>
<tr>
<td>Total Kharif Paddy</td>
<td></td>
<td>20.36</td>
<td>49.64</td>
<td>42.72</td>
<td>47.66</td>
<td>72.30</td>
<td>48.69</td>
<td>146.34</td>
<td>46.36</td>
<td>281.72</td>
<td>47.36</td>
</tr>
<tr>
<td></td>
<td>Moti</td>
<td>2.10</td>
<td>5.12</td>
<td>1.68</td>
<td>1.87</td>
<td>1.92</td>
<td>1.29</td>
<td>7.92</td>
<td>2.51</td>
<td>13.62</td>
<td>2.29</td>
</tr>
<tr>
<td></td>
<td>Jaya-2</td>
<td>1.44</td>
<td>3.51</td>
<td>0.00</td>
<td>0.00</td>
<td>2.88</td>
<td>1.94</td>
<td>4.56</td>
<td>1.44</td>
<td>7.50</td>
<td>1.26</td>
</tr>
<tr>
<td></td>
<td>Gujarat-17</td>
<td>0.00</td>
<td>0.00</td>
<td>0.30</td>
<td>0.33</td>
<td>2.64</td>
<td>1.78</td>
<td>4.56</td>
<td>1.44</td>
<td>7.50</td>
<td>1.26</td>
</tr>
<tr>
<td></td>
<td>Rupali</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.24</td>
<td>0.16</td>
<td>0.00</td>
<td>0.00</td>
<td>0.24</td>
<td>0.04</td>
</tr>
<tr>
<td></td>
<td>Gujarat-4</td>
<td>0.72</td>
<td>1.76</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.72</td>
<td>0.12</td>
</tr>
<tr>
<td>Total Summer Paddy</td>
<td></td>
<td>14.03</td>
<td>34.20</td>
<td>24.86</td>
<td>27.74</td>
<td>36.48</td>
<td>24.57</td>
<td>69.72</td>
<td>22.09</td>
<td>145.09</td>
<td>24.39</td>
</tr>
<tr>
<td>Total Paddy</td>
<td></td>
<td>34.39</td>
<td>83.84</td>
<td>67.58</td>
<td>75.39</td>
<td>108.78</td>
<td>73.25</td>
<td>216.06</td>
<td>68.45</td>
<td>426.82</td>
<td>71.76</td>
</tr>
</tbody>
</table>

K: Kharif and S: Summer

(Area in Hectare)
To judge the nature of variability of rice of the trend, it categorized into three groups. These groups are:

**A: Maximum yield level**
(a) Consistently rising trend in yield level  
(b) Moderately rising trend in yield level and  
(c) Poor rising trend in yield level

**B: Minimum yield level**
(a) Consistently well improvement in yield level  
(b) Consistently moderate rising in yield level and  
(c) Very poor rising trend in yield level

The results of such categorization are presented in table 3.19. The table also provides the results of categorization for paddy crop, which make comparative study of stability in growth rate of productivity. Important observations emerging from this table are as follows:

1. Based on A and B estimates, Valsad, Gandhinagar, and Vadodara Sabarkantha constituted category a or b and d or e which is a clear indication of high instability in growth of yield of total rice.

2. As per the A and B estimates, Ahmedabad, Dangs, Gandhinagar, Surat, Vadodara, Bharuch and Gujarat category a or b and d or e which is a clear indication of high instability in growth of yield of rice in kharif season.

3. Based on A and B estimates, Surat, Valsad, Kheda and Gujarat constituted category a or b and d or e which is a clear indication of high instability in growth of yield of rice in summer season.
Table 3.19:
Categorization of trend in maximum and minimum yield levels for rice crop
during 1970-71 to 2004-05

<table>
<thead>
<tr>
<th></th>
<th>Total Rice</th>
<th>Kharif Rice</th>
<th>Summer Rice</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><em>A Maximum yield level</em></td>
<td><em>A Maximum yield level</em></td>
<td><em>A Maximum yield level</em></td>
</tr>
<tr>
<td></td>
<td>(a) Ahmedabad, Valsad, Dangs, Gandhinagar, Kheda, Mehsana, Surat and Gujarat</td>
<td>(a) Ahmedabad, Dangs, Gandhinagar, Mehsana, Surat and Gujarat</td>
<td><em>(a) Surat and Gujarat</em></td>
</tr>
<tr>
<td></td>
<td>(b) Vadodara, Bharuch and Sabarkantha</td>
<td>(b) Vadodara, Bharuch, Valsad, Kheda and Sabarkantha</td>
<td><em>(b) Valsad and Kheda</em></td>
</tr>
<tr>
<td></td>
<td>(c) Panchmahals</td>
<td>(c) Panchmahals</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>B Minimum yield level</em></td>
<td><em>B Minimum yield level</em></td>
<td><em>B Minimum yield level</em></td>
</tr>
<tr>
<td></td>
<td><em>(d) Valsad, Gandhinagar and Sabarkantha</em></td>
<td><em>(d) Sabarkantha and Surat</em></td>
<td><em>(d) Kheda</em></td>
</tr>
<tr>
<td></td>
<td>*(e) Ahmedabad, Vadodara, Bharuch, Dangs, Surat and Gujarat</td>
<td>*(e) Ahmedabad, Vadodara, Bharuch, Valsad, Dangs, Gandhinagar, Kheda and Gujarat</td>
<td>*(e) Valsad, Surat and Gujarat</td>
</tr>
<tr>
<td></td>
<td><em>(f) Mehsana and Panchmahals</em></td>
<td><em>(f) Mehsana and Panchmahals</em></td>
<td></td>
</tr>
</tbody>
</table>

THE STRATEGY OF RICE

In the absence of certain strategic measures the trend as noted above would weaken the overall economy of rice cultivation in Gujarat. Among the food grains, cultivation of rice has been facing some serious difficulties. For strategic cultivation of the rice economy of the state, the following steps are essential:

1. A shift in relative area under rice cultivation from rainfed condition to irrigated areas
2. Shift in area under rice from kharif cropping pattern to summer cropping, where an irrigation facilities is easily available.
3. To use new methods of paddy cultivation in the low irrigated area's of paddy because it save irrigation water, make and efficient static use of inputs and get more production like System of Rice Intensification.
4. A provision of regular irrigation is to be made at the time of requirement in kharif season and summer season. This can be attained through proper planning of irrigation development and its distribution network. This strategy would help stabilizing yield per hectare.

5. Evolution of a new but successful high yielding varieties of paddy well suited to irrigated areas should be transformed to rainfed areas. While evolving these varieties, location and season specific problems should be properly tackled. This would require concentrated research efforts in proper direction.

6. Major extension efforts need to be made to make acceptable the advances available in technology among the paddy growers. Generally a wide gap is observed on one hand and farm level on the other. Appropriate management including interface between extension and research scientists, needs to be undertaken.

7. Adequate preliminary arrangements should be made to supply the strategic inputs along with the necessary extension services in order to apply adequate doses of these inputs.

8. Adequate market arrangements for effective price of paddy. At present the prevalence of exploitative nature of private trades practices leads to a situation of all benefits accruable to paddy growers are lost in the margins of trades.

9. Adequate market support in respect of facilities for sale of paddy.

10. Provision, production and evolution of quality pesticides with assured availability at reasonable prices to constantly and effectively control pests and diseases in respect of the present high yielding varieties because the new developed varieties of paddy is not successful in well growing land of paddy in major paddy growing districts of the state.

11. Evolution of short duration high yielding varieties for irrigated farming for both seasons i.e. kharif and summer seasons.

12. Effective and sustained measures to educate farmers about the correct and scientific methods of using various inputs, including fertilizers as well as irrigation water.

13. Assured and timely provision of strategic inputs without any intermittent delay or failure in their supply like electricity.

14. Introduction and awareness of insurance schemes to paddy crop.

15. Development of necessary infrastructural facilities, wherever necessary.
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