Economic planning can play an important role in narrowing down the regional disparities. Although the existence of these disparities was recognized and the need for their reduction was realized by our planners, yet concrete efforts in that direction were made only during the Third Five Year Plan. The shortage of resources presented a major constraint for a balanced development of all the regions in the early years of India's economic planning. Many researchers argued that rising regional disparities were typical of the early stages of economic development while reduction in those differentials would automatically follow as the economy started developing. At the same time, it was also felt that these disparities must be narrowed down, since left to themselves, these differences could be self-accentuating and a further increase in regional disparities would generate such pressure which can create inter-regional tensions and impose serious strains on the entire political system itself.

At the time of independence, different states/regions of India had attained varied levels of development because of historical factors, various developmental efforts made at the state level and varied natural resource endowments. Even in the agricultural sector, during the first Three Five Year Plans, production/productivity had differed vastly among states/regions,
and these disparities were noted and discussed but no action followed for bridging the gaps. With a view to maximise the increase in total agricultural production, the financial and technical inputs were concentrated in potential areas.

Near home, agricultural modernisation in Punjab stretched over a relatively longer period. Consequently, Punjab has emerged to be the most progressive state, but all its parts are not equally developed. There exist inter-district as well as inter-region disparities in agricultural development in Punjab.

A look into the historical record reveals that under British rule, pattern of heavy public investment, especially on canal irrigation, was associated with the emergence of disparities in agricultural sector in Punjab. The canal colonies had a highly developed agriculture followed by the districts of the central plain region, sub-montane region, south and northern regions of Punjab.

After independence, during the first phase of agricultural development (1947-60), implementation of various policies/programmes for the development of agricultural sector, namely, public investment on creation of institutional and economic infrastructure (major and medium irrigation works, power, land reclamation, consolidation of land holdings and strengthening of credit structure) was of such a type that their benefits were more or less, equally shared by all the areas of the state.
However, during the initial years of the second phase (1960-83) of agricultural development, it was felt that concentration of financial resources in potential areas was a compelling policy option.

It was only during the Fifth Five Year Plan that emphasis got shifted to the development of backward areas i.e. bet areas, border areas, and hilly areas. Since 1963, Punjab Planning Board is also preparing a Districtwise Distribution of the Divisible Plan Scheme for the balanced development of all the districts. District-wise allocation of funds under different sub-heads are made keeping in view their level of sectoral development. The overall impact of these developmental efforts is far from clear but for some impressionist's views.

The main theme of the present study was to examine whether the disparities in the level of development of the agricultural sector had shown a convergent or divergent trend under economic planning since independence. It was also sought to be probed as to what extent the pattern of public investment in agricultural sector was responsible for the observed trends in disparities in agricultural sector among the districts of Punjab.

In specific terms, the present study was a bid to (i) determine the extent of inter-district variation in agricultural development; (ii) identify the factors responsible for those disparities; (iii) quantify and analyse the role of public investment/policy vis-a-vis these inter-district disparities and (iv) suggest ways and means of attaining the desired objective of balanced regional development.
For empirical investigations, the secondary data were used in the present research. District-wise data, covering different aspects of agricultural development, were obtained from 'Statistical Abstracts of Punjab' as well as from concerned offices. For exponential convenience, the study was divided into three main sections dealing with measurement of these disparities, determinants thereof and the inter-relationship between public investment and technological changes. The main findings of our study are reported below in the same order.

Section I. **Measurement of the Level of Agricultural Development at the district/region level in Punjab.**

This section was further divided into three sub-sections involving (a) brief review of the physiographical characteristics of the three regions of Punjab, (b) measurement of the diversities as well as the disparities in agricultural development at the sectoral level, (c) measurement of the aggregate level of agricultural development as well as the overall level of development.

Ia. **Physiographical Characteristics of Punjab**

On the basis of the physiographical characteristics namely, geology, soil structure, rainfall and ground water resources, the state was divided into three regions - sub-montane region, central plain region and Southwestern region.

The sub-montane region, comprising the districts of Gurdaspur, Hoshiarpur and Ropar, has bad geology and poor soil.
structure, poor ground water resources but this region has sufficient annual rainfall. The central plain region, comprising the districts of Ludhiana, Jullundur, Amritsar, Kapurthala, Sangrur and Patiala, has fertile soil and rich ground water resources but it has medium rainfall. The Southwestern region, comprising districts of Ferozepur, Faridkot and Bhatinda, has comparatively less fertile soil. In most part of this region, soil and ground water resources are poor. Also, this region has the lowest rainfall.

Ib. Diversities and Disparities in Agricultural Development at the Sectoral Level

Diversities in agricultural development constituted the land use pattern and demographic pattern whereas disparities in agricultural development constituted the mechanisation, adoption of bio-chemicals, irrigation, education, economic infrastructure and co-operatives development indices. Principal component analysis was applied to construct each of the respective development index.

Ib.1 Diversities in Land Use Pattern

Inter-district diversity in land use pattern remained the same over time. The percent of variation explained by the selected indicators being 69.01 percent and 68.87 percent during 1961 and 1981, respectively. But the range between the highest and lowest factor scores increased from 4.30 - -3.82 in 1961 to 7.420 - -7.524 during 1981. Moreover, the diversities in land use
pattern had become more region specific over time, as the districts falling in different physiographic regions had clustered over time. Districts of the sub-montane region were characterised with higher percent of area under forests, low percent of net area sown and comparatively higher percent of cash crop production. On the other hand, districts of the southwestern region were characterised with high percent of net area sown, current and fallow land and area under fruits and vegetables.

Ib.2 Diversities in Demographic Pattern

Diversities in demographic pattern measured in terms of percent of variation explained declined from 93.47 during 1961 to 80.63 percent during 1981. But within the districts, this gap widened overtime i.e. the range between the highest and the lowest factor score being 3.19 - -5.57 and 8.53 - -8.796 during 1961 and 1981 respectively. Over the entire period demographic pattern remained region specific as the districts falling in different physiographic regions remained grouped together. Districts of the southwestern region were characterised with the high land-man ratio comparatively higher working population in agricultural sector and low density of population whereas districts of sub-montane region had the low urbanisation and the high inequality in the distribution of number of operation holdings.

Ib.3 Disparities in the Level of Adoption of Mechanisation in Agricultural Sector

Disparities in the level of adoption of mechanisation in agricultural sector declined from 83.88 percent during 1961 to
77.22 percent during 1981. But the mechanisation in agricultural sector remained concentrated in the districts of the central plain region and these districts improved their relative positions over time. Though not much differences existed between the other two regions but districts of the southwestern region lost their initial relative position due to the lowest adoption level of electric pumps during 1981.

Disparities in the level of adoption of Bio-Chemical Technology.

Disparities in the level of bio-chemical technology changes significantly overtime i.e. percent of variation explained being 71.16, 85.33 and 72.77 percent during 1961, 1971 and 1981 respectively. Though not much regional differences existed in the adoption level of bio-chemical technology, yet central plain region retained its supremacy (though within the region there are slight changes); the districts of southwestern region improved their relative positions whereas districts of the sub-montane region came out with the low adoption level of bio-chemical technology in agricultural sector.

Disparities in the Development of Irrigation Sector

Disparities in the level of development of irrigation sector increased from 72.76 percent during 1961 to 86.36 percent during 1971 but it again came down to 81.13 percent during 1981. Central plain region had highly developed irrigation sector followed by the districts of the southwestern and sub-montane
regions respectively. These inter-regional variations in the development of irrigation sector remained quite glaring over the period 1971 and 1981. Besides it, sources of irrigation became highly region specific during 1971 i.e. central plain region came out with highly developed tubewell irrigation whereas southwestern region had highly developed canal irrigation. But during 1981, region specificity of development of irrigation sector narrowed down with respect to canal irrigation but it still existed in terms of tubewell irrigation.

Ib.6 Disparities in the Development of Education Sector

Disparities in the level of development of education sector increased from 87.80 percent during 1960-61 to 95.93 percent during 1981. Sub-montane region had comparatively highly developed education sector as its districts improved their relative positions overtime. Some districts of the central plain region lost their initial relative position over time and this region has both developed as well as backward districts. The southwestern region had the least developed education sector.

Ib.7 Disparities in the Level of Development of Infrastructural Facilities.

Disparities in the level of infrastructural facilities decreased from 93.14 percent during 1960-61 to 80 percent during 1981. Infrastructural facilities remained highly concentrated in the districts of the central plain region. Districts of the sub-montane region improved their relative positions and had an average developed economic infrastructural sector. Districts of
the southwestern region remained backward with respect to
economic infrastructural facilities.

Ib.8 Disparities in the Level of Development of Co-operative
Sector

Disparities in the level of development of co-operative
sector declined from 83.80 percent during 1960-61 to 77.46 percent
during 1981. Though no noticeable difference existed between
central plain and sub-montane region but southwestern region had
the least developed co-operative sector during the period under
study.

Ic. Aggregate Levels of 'Agricultural Development' as well as
the 'Over All Level of Development.'

Principal component analysis had been applied at the
second stage, to construct aggregate 'Agricultural Development'
as well as the 'Over All Development' indices by treating the
sectoral indices, namely, mechanisation, bio-chemical, irrigation,
education, economic infrastructure and co-operatives, as raw data.
"Agricultural Development Index" constituted the first three
sectoral indices whereas "Over All Development Index" constituted
all the six sectoral indices.

Ic.1 Agricultural Development:

During 1961, inter-district variations in agricultural
development were quite high ranging between factor scores of
25.96 - -12.69, but inter-regional variations were not visible
as the districts from different regions were distributed among
the different categories of developmental level. Overtime, inter-district variations in agricultural development slightly declined, the range between the highest and lowest factor scores being 16.98 - -14.73. But inter-regional variations became more glaring as all the districts from the central plain region got placed in highly developed and developed categories whereas districts of the sub-montane and southwestern region remained in the backward and highly backward categories of development. Thus to conclude, inter-district variations in agricultural development slightly declined over time but inter-regional variations became more pronounced over time.

### 2 Over All Level of Development

As far as the level of over all agricultural development is concerned, inter-district variations slightly increased and inter-regional disparities became more glaring over time. The variations explained by the selected indices of 'Composite Development Index' (representing the overall level of development) increased from 68.87 percent to 87.88 percent during 1961 and 1981. Besides it, the range between the highest and the lowest factor scores also increase (34.48 - -14.410 during 1961 to 26.544 - -24.070 during 1981). Inter-regional variation became more glaring as more districts from the central plain region had joined the highly developed and developed categories whereas districts from the sub-montane and southwestern region remained in the highly backward or backward categories of development (Even Hoshiarpur and Ropar districts respectively shifted from highly developed and developed category to highly backward category.
of development during 1981). Thus, 'Overall' agricultural development was more concentrated in the central plain region during 1971 and 1981.

The upshot of the preceding analysis was that districts from the central plain region had emerged as the highly developed and developed ones. Bestowed with good ground water resources these districts had highly developed irrigation sector and had a comparatively higher level of adoption of technology. These districts had also been provided with better economic infrastructural facilities. On the other extreme, sub-montane and southwestern regions had disadvantages both in terms of natural resources as well as in sectoral development.

We may sum up this section by reporting that inter-district and inter-regional variations in agricultural development had shown divergent trend over time.

Section II.

Sources of Inter-District Variations in Agricultural Development in Punjab (with Special Reference to Public Investment)

In this section the analysis was done on the following lines:

(a) To study the changes in the broad pattern of agricultural development as well as in the main determinants of land productivity, Factor Analysis Technique had been applied; (b) to separate the effect of each of these main determinants on
agricultural production, regression analysis technique was used; (c) to examine the stability of the productivity variation function, Chow Test and Dummy Variable Regression Model have been applied.

IIa Pattern of Agricultural Development and the Main Determinants of Land Productivity (Factor Analysis).

IIa.1 Pattern of Agricultural Development:

IIa.1.1 During 1961, mechanised farming explained the highest inter-district variations in agricultural development whereas structural diversity oriented variables, irrigation oriented variables along with its resource (tubewell irrigation) development of infrastructure and land man ratio explained the second highest variation in agricultural development. Use of bio-chemical changes explained the next highest variation in agricultural development.

IIa.1.2 During 1971, use of biochemical inputs together with a few infrastructural development oriented variables, composition of working force and gross irrigation explained the highest inter-district variations in agricultural development. However, structural diversity along with irrigation oriented variables with its resource (canal irrigation) explained the next highest variation in agricultural development. Pumping sets, co-operatives, land use pattern, land man ratio explained the remaining highest inter-district variation in agricultural development.
IIa.1.3 During 1981, electric pumps, use of bio-chemical inputs, composition of working population, tubewell irrigation and provision of infrastructural facilities explained the highest inter-district variations whereas structural diversity, irrigated area, land-man ratio and a few co-operative oriented variables explained the next highest inter-district variations. Tractors and pumping sets explained the remaining inter-district variations in agricultural development.

IIa.2 Determinants of Land Productivity

IIa.2.1 During 1961, production of crops was highly correlated with mechanisation, irrigation and a few economic infrastructural related variables. As far as subsidiary occupation in agricultural sector was concerned, animal husbandry was more popular in the districts with high land-man ratio as well as with higher percent of working population in agricultural sector. But opposite was true for the adoption of poultry as an subsidiary occupation i.e. districts with lowest land-man ratio and higher working population had comparatively higher adoption of poultry as subsidiary occupation.

IIa.2.2 During 1971, production of crops per unit of net area and cropped area was highly correlated with tubewell irrigation, technological changes and development of economic infrastructural facilities. Production of crops measured on per worker and per cultivator basis was highly correlated with high land-man ratio, high percent of irrigated area and number of tractors.
IIa.2.3 During 1981, though the broad pattern of inter-correlation between input and output variables remained the same (as it was during 1971), but a few changes were observed. Production of crops measured in terms of per hectare of net area and cropped area was highly correlated with variables representing development of ground water resources; adoption of bio-chemical inputs and development of economic infrastructural facilities. Production of crops measured in per worker and per cultivator terms was highly correlated with high land-man ratio, a few technological oriented variables (tractors and pumping sets) and high percent of irrigated area.

As far as subsidiary occupation was concerned, pattern of adoption of subsidiary occupation in agricultural sector remained the same over time as it existed during 1961.

The main conclusions that emerged from our analysis in this section are given below:

(i) Development of ground water resources, provision of economic infrastructural facilities and use of bio-chemical technology come out as the main determinants of agricultural development over time. Whereas structural diversity and actual irrigated area (percent net area and gross irrigated area) are playing the same role as they did during 1961.

(ii) As far as the determinants of land productivity were concerned, inter-correlation between the production of crops per unit of net sown area and cropped area with variables representing development of ground water resources, bio-chemical inputs and development of infrastructural facilities had highly improved.
Animal husbandry was highly correlated with high land-man ratio whereas opposite was true for poultry as a subsidiary occupation i.e. districts with lowest land-man ratio have comparatively higher adoption level of poultry as a subsidiary occupation.

To sum up, development of ground water resources, economic infrastructural facilities and use of bio-chemical inputs were the main determinants of agricultural development as well as that of land productivity over time. However, determinants of subsidiary occupation (animal husbandry and poultry) remained the same over time.

IIb. Results of Regression Analysis

The main findings of this exercise were:

(i) The variables included with the regression equation explained 79 percent of the total inter-district variations in agricultural productivity;

(ii) Tubewell irrigation, cropping intensity, public expenditure through agricultural department and loans advanced by co-operatives significantly explained inter-district variations in agricultural productivity;

(iii) The coefficients for fertilizer use and road density had expected (positive) signs but were not statistically significant. Use of chemical fertilizer was tied up with the co-operative credit and was also highly influenced by tubewell
irrigation, cropping intensity and use of tractors. Road density was highly correlated with power consumption;

(iv) Tractors and power consumption had negative values but were not statistically significant. Power consumption influenced the technical inputs through tubewell irrigation and variation explained by power consumption was subsumed in the variation explained by tubewell irrigation. Tractorisation of an area largely goes with the availability of cooperative credit.

(v) Provision of general infrastructural facilities (loans advanced by cooperatives and power consumption) were a good determinants of the use of technical inputs (fertiliser use and tractors) and these technical inputs further raised the cropping intensity;

(vi) Public expenditure on various programmes and schemes which directly worked for the increase in agricultural production worked more effectively, if the farmers were provided with adequate loan facilities as well as with irrigation facilities.

This exercise clearly revealed that tubewell irrigation, government efforts for promotion of agricultural production through agricultural department, availability of loans for the supply of inputs and cropping intensity was significantly explained inter-district variation in agricultural productivity.
IIc Regional Effect

To examine the differences in the estimated function and each of the regression coefficient across region, with somewhat different agro-climatic conditions, the Chow test and dummy variable analysis were applied respectively.

IIc.1 The Chow Test

The estimated function within the three region taken together differed significantly.

IIc.2 Dummy Variable Analysis

The statistically significant values of the regression coefficients for each of the region as well as between the two regions gave the following results.

(1) Tubewell irrigation, public expenditure through agricultural department and cropping intensity significantly effected agricultural production in region 8 (Central plain region) where as in region C (Southwestern) tubewell irrigation, public expenditure and loans advanced by cooperatives significantly effected agricultural production. But none of the regression coefficients was statistically significant in region A (sub-montane region). It shows that due to poor geology and bad soil structure, these very inputs might have been less effective.

Section III

In this section, an attempt had been made to establish the relationship between the spread of new technology and
public expenditure. This section was also divided into three sub-sections:

(a) Spread of new technology was examined with the help of relative indices for each input in isolation. For a particular district, the index was obtained as a ratio of the figures for the district to the state figure. In addition exponential growth rates of each of the technical inputs were also obtained; (b) growth pattern of annual plan schemes (Divisible plan outlay and power expenditure through Punjab State Electricity Board) was studied using the same tools as for the spread of technology; (c) link between the spread of new technology and the plan outlay was examined with the help of simple correlation Analysis, both with and without time trend.

IIIa Spread of New Technology:

All the four selected components of agricultural technology grew differentially in various regions of Punjab. Districts of the central plain region started with higher adoption level of technology in agricultural sector. But its districts depicted differential growth rates over time. Ludhiana, Jullundur and Amritsar districts depicted lowest growth rates over time but these districts retained their supremacy due to higher adoption level in the base year. Sangrur, Patiala and Kapurthala slightly improved their adoption level due to comparatively higher growth rates. With the result, relative index of tractors, H.Y.V. and fertilizers declined over time but remained the same for the pumping sets. However, ratio of
the share of the region in individual component to its share in cultivated land declined over time. Even though, the same continued to be the highest among all three regions.

The sub-montane region started with comparatively lower adoption of technology in agricultural sector. Though its districts depicted high growth rates over time, but this region had lower adoption of technology in agricultural sector, especially that of tractors and pumping sets. The relative index for pumping sets and fertilizer use increased but it slightly declined for tractors and H.Y.V. seeds. The ratio between the percent share to total cultivated land and percent share to total pumping set and fertilizer increased but opposite was true for tractors and H.Y.V. of seeds.

The districts of the southwestern region had the lowest adoption level of technology in agricultural sector (except that of tractors) during the base year. With higher growth rate over time, level of adoption of technology improved but this region had the lowest number of pumping sets. Percent share to total for the each of technical inputs as well as the ratio between the percent share to individual technical inputs and the percent share to total cultivated land improved over time, with the exception of pumping sets.

IIIb. Growth Pattern of Plan Outlays:

The detailed analysis of the growth and trends of selected components of plan outlay showed that efforts were
made for raising the economic levels of comparatively less developed districts through the district plan outlays.

IIIc. **Link Between the Spread of Plan Outlays and Growth of Technology**

Poor correlation between Annual Plan outlays and technical inputs revealed that public investment failed to induce private investment.

The above stated results very strongly suggest that rich natural resource endowments together with development of ground water resources, provision of economic infrastructural facilities and public investment through agricultural department explained the inter-district variation in agricultural development/productivity. The government efforts through district plans failed significantly to induce private investment in agricultural sector.

This empirical exercise, as a whole, brings some bitter realities of development dynamics to the fore. While state as a legislative body and funds allocating agency is not totally devoid of a constructive role, its potency as a homogenising agent is limited. It goes without saying that deliberate state efforts can modify the natural development pattern but the role of natural endowments cannot be altogether altered, however well meaning the state might be. In the context of agricultural development, we find that the favourably endowed central plain region retained its overall supremacy in spite of concentrated
state efforts to bring the other regions at par. The other regions continued to lag behind in terms of agricultural development. Not to belittle the positive effect of infrastructure but the role of local initiative and physiographic conditions appears to be a dominant one. Therefore, at the present level of agricultural technology one cannot expect a homogeneous level of agricultural development in the state whatsoever be the magnitude of government efforts. Unfavourably placed regions ought to be provided with alternative developmental activities, through the development of secondary and tertiary sectors, so that they catch up with the central plain region in terms of overall development. Obsession with agricultural modernisation in the backward districts does not seem to be the right policy. State efforts/funds need to be directed in the respective areas in conformity with their natural factor endowments.