Summary

And

Suggestion
Uttarakhand is a agriculturally backward area. Here agriculture is the main source of revenue as the bulk of population or 80 per cent of the total population survives on agriculture. Variations in altitude, soils and climate have introduced differences in agricultural practices from place to place in the study region. Agriculture was however practiced here on conservative lines in the recent past and there was no real and serious effort on the part of cultivators to adopt new methods of agriculture. A low agricultural production and rapid growth of population has been major problems of the region. To fulfil the requirements of foodgrains, special attention is being paid towards the enhancement of their agricultural output, with an increased use of irrigation, chemical fertilizers, HYV seeds and infrastructural facilities. There has now been significant increase in the available food resources. However, the distributional pattern of institutional and technological indicators are not uniform in Uttarakhand which causes regional imbalances in agricultural development.

The net sown area in Uttarakhand during 1979-80 was 13.27 per cent (7.06 lakh hectares) of the total reported area, which decreased to 12.89 per cent (6.92 lakh hectares) in 1994-95. Similarly the area sown more than once has also decreased from 9.0 per cent (4.31 lakh hectares) in 1979-80 to 9.36 per cent (4.49 lakh hectares). The gross cropped area was 11.37 lakh hectares in 1979-80 which increased to 11.41 lakh hectares in 1994-95 but their percentage to the total reported area slightly decrease from 21.37 per cent to 21.26 per cent during the period 1979-80 to 1994-95. The percentage decrease in gross cropped area is due to new construction of settlement and roads in the region.
The production obtained from the food crops recorded a steep rise from 24.96 lakh tonnes to 44.88 lakh tonnes during the period 1979-80 to 1994-95. Steep increase in production is the result of general awakening of the farmers and the diffusion of technological and institutional inputs. The impact of these efforts was remarkable in the irrigated valleys and was negligible in other hill zones.

An analysing the growth rate in area and production of individual crops in Uttarakhand indicates that among cereals, wheat is the first ranking crop that occupied 367.71 thousand hectares in 1979-80 and 371.39 thousand hectares in 1994-95.

The production of wheat continuously increased from 441.92 thousand tonnes in 1979-80 to 678.76 thousand tonnes in 1994-95. The overall linear growth rate of area under wheat increased by 53.50 per cent, while production increased by 52.25 per cent during the period studied. After wheat, rice is the second leading crop in the study area. Its areal extent has slightly decreased from 283 thousand hectares in 1979-80 to 280.41 thousand hectares in 1994-95, but its quantum of production has recorded a handsome increase from 326.38 thousand tonnes in 1979-80 to 551.19 thousand tonnes in 1994-95. The linear growth rate of area under rice decreased by 0.9 per cent, while the production increased by 68.8 per cent during this period. The area under maize was 38.06 thousand hectares in 1979-80, which decreased to 31.69 thousand hectares in 1994-95. However, the production under maize sharply declined from 43.65 thousand tonnes in 1979-80 to 37.86 thousand tonnes in 1994-95. The area under barley has also declined from 29.97 thousand hectares in 1979-80
to 28.40 thousand hectares in 1994-95, while the production has slightly increased from 35.20 thousand tonnes in 1979-80 to 35.72 thousand tonnes in 1994-95. The linear growth of area and production indicates that the area under barley decreased by 5.23 per cent, while production increased by 1.48 per cent from 1979-80 to 1994-95.

The area under pulses have increased in fifteen years except in case of gram and masoor, while the production recorded an increased in all the pulses except gram. Besides, masoor is the leading crop among other pulses in Uttarakhand. It occupies largest area and improved its position in production. The area under masoor was 15.54 thousand hectares in 1979-80, and 15.22 thousand hectares in 1994-95. As against this the production increased from 8.67 thousand tonnes in 1979-80 to 11.63 thousand tonnes in 1994-95. The linear growth rate of area under masoor decreased by 2.02 per cent, while the production increased by 34.10 per cent during the period 1979-80 to 1994-95.

Urd ranked second after masoor, the area under Urd was 5.32 thousand hectares in 1979-80, but it recorded an excellent increase to 8.34 thousand hectares in 1994-95. The production also increased from 2.36 thousand tonnes in 1979-80 to 3.67 thousand tonnes in 1994-95. Arhar is another important crop whose area increased to 1.64 thousand hectares in 1994-95 from 1.19 thousand hectares in 1979-80. The production of arhar also increased during the period 1979-80 to 1994-95. The area and production under gram decreased from 4.29 thousand hectares and 1.92 thousand tonnes respectively in 1979-80 to 1.77 thousand hectares and 1.56 thousand tonnes in 1994-95. Lastly the peas
covered small area i.e. 0.85 thousand hectares in 1979-80, which increased to 2.32 thousand hectares in 1994-95, and production also increased from 0.56 thousand tonnes in 1979-80 to 1.78 thousand tonnes in 1994-95. The trends of growth in area and production indicates that the area under peas had an excellent increase by 172.53 per cent, while the production increased by 217.58 per cent during the period studied.

Among oilseeds, soyabean, rapeseed and mustard, and sesameum have achieved leading position in Uttarakhand. The area under soyabean was 8.45 thousand hectares in 1979-80, which increased to 18.68 thousand hectares in 1994-95, and its production increased from 12.35 thousand tonnes in 1979-80 to 25.0 thousand tonnes in 1994-95. The growth rate of area and production under soyabean increased by 121.07 per cent and 103.02 per cent respectively during the period 1979-80 to 1994-95. The area under rapeseed and mustard has increased from 11.41 thousand hectares to 12.88 thousand hectares during the period 1979-80 to 1994-95. Similarly the production has increased from 5.11 thousand tonnes in 1979-80 to 10.41 thousand tonne in 1994-95. The phenomenal increase is due to the favourable climatic conditions of the study area. The area under sesameum was 1.87 thousand hectares in 1979-80, which increased to 2.95 thousand hectares in 1994-95, conversely the production declined from 0.46 thousand tonnes to 0.40 thousand tonnes during the period 1979-80 to 1994-95.

Uttarakhand is not an important producer of sugarcane as compared to the sugarcane belt of western and eastern Uttar Pradesh. The area under sugarcane has increased from 38.49 thousand hectares in 1979-
80 to 49.91 thousand hectares in 1994-95 and the production increased from 1508 thousand tonnes to 2925 thousand tonnes during the period 1979-80 to 1994-95. Potato and onion are getting popular in Uttarakhand and its area and production both are gradually increasing. The area under potatoes, was 6.90 thousand hectares in 1979-80, which rose up to 14.41 thousand hectares in 1994-95. Similarly the production has also recorded increase from 90.28 thousand tonnes in 1979-80 to 260.49 thousand tonnes in 1994-95. The area under potato increased by 108.95 per cent, while production increased by 188.54 per cent. The area under onion has increased from 0.87 thousand hectares to 1.23 thousand hectares during the period 1979-80 to 1994-95. The production also significantly increased from 13.56 thousand tonnes in 1979-80 to 16.40 thousand tonnes in 1994-95. The development and expansion of irrigation facilities have increased the irrigated area under various food crops in Uttarakhand. The food crops area under irrigation was 3.00 lakh hectares in 1979-80, which increased to 3.78 lakh hectares in 1994-95. Among all the food crops, sugarcane was heavily irrigated and more than 90 per cent of its area received irrigation. The area increase under irrigation is due to increase in the number of tubewells, pumpsets, canals and irrigation by other sources (ponds, lake, wells and tanks) in Uttarakhand. In 1979-80, about 37 per cent of the total area was under irrigation. But after farmers awakening encouragement of governmental agencies, and expansion of irrigation facilities, extensive area of food crops came under irrigation and about 45 per cent area was irrigated in 1994-95.
Gross irrigated area as a percentage to gross cropped area is large in Dehradun and Nainital, but in other districts, it is relatively low. In Chamoli, for instance this figure was as low as 7.32 per cent in 1994-95. The net irrigated area by different sources was 1,94,127 hectares in 1979-80, which increased to 2,45,041 hectares in 1994-95. The high percentage of net irrigated area was seen in south eastern and south western part, namely, Nainital and Dehradun district of Uttarakhand. In this districts, the concentration of tubewells and pumpsets was quite high, owing to better supply of electricity in the tarai-bhabar tract, but in remaining districts these sources are completely absent owing to the stony hilly areas. The irrigation is mainly done through canal like gools and other sources such as ponds, lake, wells and tanks. The increase in irrigated area may be seen as glimpse of farmers awakening and the beginning of revolution, which helps in agricultural development of Uttarakhand. The use of fertilizers (NPK) in Uttarakhand was 35,580 metric tonnes in 1979-80, which increased to 76,983 metric tonnes in 1994-95. The total consumption of fertilizers has increased from 31.26 kg per hectare of cropped land in 1979-80 to 67.43 kg per hectare in 1994-95. The highest consumption of fertilizers was reported in south eastern and south western part of Uttarakhand. It includes the districts of Nainital (206.09 kg per hectares) and Dehradun (46.37 kg per hectare). The low level of consumption was recorded in remaining districts namely, Almora, Pithoragarh, Chamoli, Uttarkashi, Tehri Garhwal and Pauri-Garhwal. The number of tractors per thousand hectares of cultivated land is very low, being of 5.53 tractors in 1979-80. This ratio however, increased to 15 tractor per thousand hectares
of cultivated land in 1994-95. The concentration of tractor is greater in only Nainital and Dehradun district. Use of pumpsets also follows the same pattern. The total area under HYV of seeds was 3,15,476 hectares, which rose upto 6,83,543 hectares in 1994-95. The high yielding seeds programme has been successful in tarai-bhabar tract of the study area, while in other parts of Uttarakhand, the adoption of this technology has been very slow. It is observed that the number of agricultural credit societies per lakh of population decreased during the period 1979-80 to 1994-95. The farmers of Uttarakhand therefore, are facing acute financial problem and are unable to invest in their farms. The number of agricultural workers to the main workers has also decreased from 75.23 per cent in 1979-80 to 64.53 per cent in 1994-95. This is due to the shifting of workers towards the secondary and tertiary sector. The percentage of agricultural workers to the main workers is decreasing very fast in Naintal and Dehradun districts. The percentage of literate persons to total population was 31.02 per cent in 1971, which increased to 48.78 per cent in 1991. The highest concentration of literate persons has been registered in south-western (Dehradun district) and south central (Pauri-Garhwal district) part of Uttarakhand, while the low concentration is reported in north-western (Uttarkashi district) and west central (Tehri Garhwal district) part of the area studied.

Land holding is the basic unit of decision making in agriculture. The increase in population has resulted in the fragmentation of land holdings, making them uneconomical, more than 70 per cent of the farmers belong to the marginal class with less than one hectare of
cultivable land. It is obvious from the analysis that only two categories viz those below one hectare and between one to two hectares of land contribute 88 per cent of the total holdings in Uttarakhand. Subsistence type of farming is practiced in this area because majority of the farmers depend on small and marginal holding for their sustenance.

The study of spatio-temporal development of agriculture with reference to agricultural productivity for the two period of time (1979-80 and 1994-95) indicates that during one and a half decades, there was a shifting of districts of high, medium and low productivity. During 1979-80, the area of high productivity region was concentrated in south-eastern (Nainital district) east-central (Almora district) and north-eastern (Pithoragarh district) part of Uttarakhand. However, in 1994-95 the high productivity region scattered over south-eastern (Nainital district) and south-western (Dehradun district) part of the area studied. It is observed that Dehradun improved its productivity and was placed under high productivity region, because the farmers of this region are more enlightened and are aware of the advantage of technological and institutional inputs. The areal change in agricultural productivity indicates that the extent of high productivity region of cereals has increased by 24.80 per cent and that of low productivity region by 7.31 per cent, while the medium productivity area of cereals decreased by 36.34 per cent. The decrease of area under medium productivity of cereals is due to the fact that most of the area has become an area of high and low productivity region. The areal extent of pulses under high productivity region increased by 19.18 per cent and medium productivity region by 29.97 per cent, while
the area under low productivity decreased by 30.70 per cent. The decrease in low productivity area is due to the shifting of area from low to high and medium productivity. The areal extent of oilseeds under high and medium productivity increased by 56.41 per cent and 251.95 per cent respectively during 1979-80 to 1994-95, while the low productivity area decreased by 48.95 per cent. The area under oilseeds has increased during one and a half decades. The areal extent of cashcrops has increased in all productivity regions from 1979-80 to 1994-95. The areal extent of high, medium and low productivity region of cashcrops has increased by 28.60 per cent, 17.95 per cent and 128.21 per cent respectively in Uttarakhand. The study indicates that the increase in area under cashcrops is due to the decrease in area under cereals. It has been observed that there is an overall increase in the productivity area under pulses, oilseeds and cashcrops excepting cereals. The increase in productivity area under these crops is due to better farm management, and use of good quality seeds, which give maximum returns to the farmers. The farmers of this region are therefore taking interest in cultivation of these crops for commercial purpose.

The factor analysis of fifteen variables for the year 1979-80 indicates that 83.86 per cent of the total variance is explained by three factors. Factor 1 explains 50.04 per cent of the total variance. The variables which have positive loadings of more than 0.50 are irrigated area to the netsown area, iron plough, followed by net sown area, consumption of fertilizers, HYV of seeds, rural electrification and literacy. The positive sign of the variables indicates the higher development of agriculture. The result of the factor scores shows that high factor scores are concentrated
in the south-eastern (Nainital district) and south-western (Dehradun
district) part of Uttarakhand, which leads to higher development of
agriculture, while the low factor scores are scattered over north eastern
(Pithoragarh district), north-central (Chamoli district) and west-central
(Tehri-Garhwal district) part of the area studied. Factor 2 accounts for
22.36 per cent of the total variance explained. It is strongly loaded on
irrigation by other sources, cropping intensity, and area sown more than
once while Factor 3 accounts for 11.46 per cent of the total variance
explained. It is negatively loaded with agricultural productivity and area
sown more than once. The result of the factor analysis for the year
1994-95, shows that 90.50 per cent of the total variance is explained by
these three factors. Factor F₁ accounts for 56.97 per cent of the total
variance explained. The highest positive loading is shown by agricultural
productivity, irrigated area to the net sown area, consumption of
fertilizers, iron plough, HYV of seeds, rural electrification and net sown
area. The positive relationship among these variables of agricultural
development indicates that high agricultural productivity is due to high
dose of fertiliser consumption, use of HYV of seeds, use of iron plough,
high irrigated area, high percentage of netsown area and extensive use of
electricity to run agricultural machinery. The high factor scores lies in
south-eastern and south-western part of the study region, comprising the
district of Nainital and Dehradun, the medium factor scores covering the
district of Almora, Chamoli and Uttarkashi while low factor scores
occupying remaining districts namely, Pithoragarh, Tehri-Garhwal and
Pauri-Garhwal. Factor 2 accounts for 22.30 per cent of the total variance
explained. It is strongly loaded on canal irrigation. Factor 3 which accounts for 11.23 per cent of the total variance explained has high loading on literacy.

Based on the composite mean Z-score, Uttarakhand has been divided into high, medium and low levels of agricultural development for the two periods, i.e. 1979-80 and 1994-95. It has been observed that even after a lapse of fifteen years, there is slight change in the spatial pattern of high, medium and low levels of agricultural development. During 1979-80, the district of Pithoragarh was under high levels of agricultural development and Uttarkashi and Tehri-Garhwal was under medium levels. But in 1994-95 Pithoragarh is replaced by Dehradun and falls under medium levels of agricultural development and Uttarkashi and Tehri Garhwal show low levels of agricultural development. The low levels of agricultural development is observed in north-central (Chamoli district), west-central (Tehri-Garhwal district), south-central (Pauri-Garhwal district) and north-western (Uttarkashi district) part of Uttarakhand. The farmers belonging to the district of high levels of agricultural development enjoy better irrigation facilities, use of fertilizers, use of HYV of seeds, and implements and machinery, while in the low levels of agricultural development, the impact of these variables are comparatively low. In subsistence farming in Uttarakhand there are no saving and therefore no capital formation takes place. There is also no will to save and invest. To earn more returns, the farmers of this region adopted the cultivation of horticulture rather than crop production.
Suggestions

The analysis so far made points to the fact that the use of technological and institutional facilities must be better managed and organised to attain proper improvements of agriculture. In order to achieve this goal, the author has lined in the light of earlier discussions to suggest some measures that can be adopted for agricultural development of the study area. These suggestions are:

i) The consolidation of Land Holdings Act, which has not yet been implemented in the region, must be enforced vigorously. The fragmentation and scattering of land holding mitigates against the development initiatives and the introduction of innovation by individual farmers. It is therefore considered that redistribution of consolidated land in the region will help in increasing agricultural production, as small farms are in general not productive in comparison to large farms.

ii) Agricultural development in Uttarakhand has to be promoted through the enhancement of productivity of the farms. Technologically, traditional farmers of the region should be trained to package of technology and plant care, which could facilitate them to go in for double cropping and better rotation of crops.

iii) Cropping pattern should be changed according to the needs of the society and to suit the capability of land.

iv) Prohibition of overgrazing must be imposed in the study area.
v) Sheet erosion results in heavy losses of soil fertility year by year and destruction of natural resources, which are of common occurrence in the hill regions, therefore it is necessary that afforestation work should be taken to arrest the losses of soil caused through erosion.

vi) Terrace farming has considerable scope in Uttarakhand and an effort should be made to raise winter corps in the study area.

vii) Irrigation facilities should be provided in mid slope and upland areas.

viii) The government should give top priority to develop irrigation facilities in its plan and policies in order to revitalise Indian agricultural technology.

xi) Agricultural credit should be provided to the farmers so that they are capable to purchase agricultural inputs like HYV seeds, fertilizers and agricultural implements and machinery.

x) Attempt should be made to introduce and propagate new agricultural technology particularly use of HYV seeds, chemical fertilizers, insecticides, pesticides, ploughing means and reclamation of waste land for cultivation.

xi) Soils in Uttarakhand suffer from the lack of nitrogen content, therefore effort should be made to convince the farmers to use green manures.

d) All kinds of incentives should be given to the farmers in the form of
subsides in cash or kind through various government and quasi-government agencies.

xiii) To ensure that only improved seeds of good quality are used by cultivators, a seed testing laboratory should be established.

xiv) For evolving a more economic and profitable cropping pattern, due consideration should be given to the soil status, irrigation facilities and climatic factors.

xv) In order to find a satisfactory answer to this apparent insensitivity to agricultural inputs, a systematic and continuous research is needed.

xvi) Electricity generation must be accelerated to pace with increasing demand of power supply for both irrigation and other agricultural purposes.

xvii) Farmers should be educated about the proper and profitable use of modern agricultural inputs.

xviii) The supply of diesel oil for agricultural purpose should be at reasonable rate, so that it helps the farmers to operate the pumping sets at the time of irrigation, because canal donot have adequate supply of water during the dry season owing to which crop suffer.