Agricultural land use in the Bist Doab experienced momentous changes during 1951-80. The net irrigated area in the region more than doubled during this period. It rose from 209.6 thousand hectares (39.6 per cent) in 1951 to 449.6 thousand hectares (63.3 per cent) in 1980, thereby adding 240 thousand hectares into the irrigation base of the Bist Doab. Nearly 78 per cent of this increase came through the augmentation of minor irrigation. Availability of subterranean water at favourable depths; predominantly flat topography; soft and deep alluvial strata, consolidation of landholdings and enactment of other land reforms; liberalization of credit facilities by the government; stretching of power lines to villages and provision of electric connections on priority basis for the tube-wells; increase in commercialization of agriculture and subsequent increase in capital with the farmers, especially after the introduction of Green Revolution technology in mid-sixties; remittances from emigrants and whole hearted efforts of the energetic farmers squarely contributed to this development. The ancient Persian Wheel and lever systems of irrigation have been completely replaced by tube-wells and pumping sets which are more reliable and efficient. Almost total reliance on power irrigation is a special feature of the study region. About 93 per cent of the irrigation in the Bist Doab at present is done through these modes. The rest is served by canals. The development
of tube-well irrigation brought new confidence among the farmers. It reduced dependence on rains and stabilized farming. Extension of cultivation, transformation of cropping pattern and increase in intensity of cropping are largely the functions of this development.

Almost all parts of the Bist Doab experienced increase in net irrigated area. The magnitude of increase, however, has been the highest over the upland plain, where plain topography, soft alluvial strata and abundance of sub-soil water have proved especially helpful. This part was the most irrigated one in 1951 and continued to lead other areas from this angle. Large scale withdrawal of underground water through tube-wells and pumping sets and consequent depletion of the same is a serious problem of this region. Water table has gone down as a result of which installation of tube-wells and pumping sets have become costlier. The conservative use of this vital resource is urgent. The areas associated with the flood plains of the two rivers come next in the increase in and prevailing position of irrigation. In these parts expansion of irrigation was restrained by floods and waterlogging particularly during earlier years of the study period. It was expedited only after the obliteration of these problems by damming the two rivers and by building embankments along their courses. Due to late start, the quantum of increase and the existing level of irrigation development
in these riverine tracts has been lower than the upland plain. The prospects of further progress in this regard, however, are very bright in these areas. There is no fear of the depletion of underground water, as it is regularly renewed by permeation from river beds. The areas associated with the hills and the foothills are least developed from irrigation point of view. The irrigation base in these tracts was low in 1951 and remained so till 1980, with limited increase during the study period. Uneven and cho-infested terrain, deep and insufficient sub-surface water, small and less productive farms and consequently limited capital with the farmers hampered the development of irrigation to a notable extent. That is why, these parts of the Bist Doab could not take full advantage of the Green Revolution technology.

Extension of cultivation to near saturation level is another noteworthy feature of the change in agricultural land use in the Bist Doab. The net area sown in the region increased by 180,384 hectares (from 529,872 to 710,256 hectares) during 1951-80. Extension of regular cultivation on almost all the culturable waste land and fallow land brought this increase. As stated earlier, the development of irrigation has played a major role in this achievement. Apart from this, increase in population pressure, mechanization of farming, increase in application of science and technology, enforcement of various land reforms, larger profits from farming and
resultant increase in awakening among farmers towards farming are the other factors which made a significant contribution in the expansion of cultivation in the region.

Flood plains registered the maximum increase in net cultivated area. Control on floods and dissipation of waterlogging particularly after the construction of dams across and artificial levees along the rivers, facilitated this positive development. As a result, these parts have attained an almost equal level as that of the upland plain in the extent of agricultural resource base. Dona tract of the Bist Doab is another area where increase in net area sown has been relatively high, due mainly to the extension of cultivation on a number of sand dunes, which were formerly lying idle. These mounds of sand were levelled with the help of modern machines and then were provided with irrigation. Rest of the Bist Doab noticed lower increase in the proportion of net area sown. Low increase in case of the upland plain is ascribed to its already broad base of cultivation. Due to fertile soils, fairly developed irrigation and flat terrain, this land use region was the most cultivated even in 1951, and the scope for further expansion was narrow. However, limited increase in net area sown in the hilly and foothill zone is due to physiographic constraints. Most of the cultivable waste land of this tract was marginal in nature and hence could not be brought under the plough due to dangers of soil erosion and the paucity of irrigation. A major share of such land was diverted
to forestry rather than cultivation. A large proportion of its total area is still under broken hill slopes and beds of seasonal streams and hence is not available for cultivation. Thus, this part of the Bist Doab had the lowest agricultural resource base in 1951 and continued to be so till 1980.

The dynamism of agriculture in the Bist Doab is reflected not only in the changes in irrigation and land use but also in the transformation of its cropping pattern. The cropping pattern in the region moved towards commercialization through greater stress on more paying and high yielding crops of wheat and rice. In fact, all those crops which became more profitable primarily through the introduction of high yielding seeds, creation of better market facilities and assurance of purchases by the state agencies, gained area and rose up in relative position in the crop complex of the region. The development of irrigation; distribution of chemical fertilizers, insecticides, pesticides etc. on credit, and greater use of machines made a significant contribution to this transformation. Area under wheat more than doubled. Rice gained ten-fold increase in hectarage and six-fold increase in percentage area. Groundnut and vegetables also registered upward trend. Maize gained in hectarage but remained stationary in proportional terms. Wheat-gram, gram, fodder, sugarcane, cotton, pulses and coarse millets suffered areal loss. Wheat experienced increase all over the Bist Doab, by capturing
area particularly from wheat-gram, gram, barley and fodder. Some of the newly reclaimed lands too were devoted to this crop. It ranks first in almost all areas of the Bist Doab. It concentrates heavily in the flood plains and the upland plain. Rice gained maximum area in the flood plains and in those parts of the upland plain where soils are heavier and where irrigation recorded substantial increase. In these areas, it consolidated its position further by replacing maize, sugarcane, cotton and fodder from many fields and therefore, displays the maximum localization at present. But for irrigation and suitable soils, it could have captured more land from competing crops in other areas too. Groundnut extended its fold further in the Dona tract (an area of aeolian soils) of the upland plain where it shows the highest concentration at present. Proportion of cropland under vegetables increased around major urban centres. Maize recorded increase in the entire eastern half of the Bist Doab, where well drained, lighter soils favour its cultivation. Decrease in cultivation of fodder is a feature of almost all areas of the study region. Increase in the yields of fodder due to introduction of quality seeds and development of irrigation, and enhanced competition from more rewarding crops largely explain this trend. Cultivation of sugarcane decreased all over the Bist Doab due basically to uncertainty in its prices and stronger competition from wheat and rice. At present sugarcane occupies relatively high proportion of the cropland around the three sugar mills. Cotton too noticed decline. In fact, the Bist
Doab remained very little known for cotton which is largely a crop of the relatively dry, southwestern areas of Punjab. The upland plain experienced the highest overall quantum of change in cropping pattern. The flood plains and the submontane zone follow in order. Greater stress on the cultivation of a few crops like wheat and rice by diverting area from others reduced diversification and enhanced specialization in cropping pattern. In this process, the crop combinations have become simpler. The number of crops decreased in most of the combinations. Foodgrains continued to dominate the cropland use of the Bist Doab throughout the study period. They shared nearly two-third of the cropped hectarage of the region in 1951 which rose to four-fifth in 1980.

It must be mentioned that different regions of the Bist Doab witnessed varied changes, face divergent problems and currently are at different levels of agricultural development. The agricultural region falling over the central upland plain recorded maximum transformation and ranks first in agricultural development. It had the broadest base of irrigation in 1951 which widened further substantially during 1951-80. No other region excels it from this viewpoint. At present it is the most irrigated region of the Bist Doab. Adoption of the Green Revolution technology without inhibitions by the more educated farmers and resultant increase in commercialization and capital with them led to faster development of irrigation in this
agricultural region. Of course, level terrain, plenty of underground water at favourable depths and soft alluvial strata facilitated this trend. In terms of the extension of cultivation, it is surpassed by the region associated with the flood plains. Despite that, it is the most cultivated agricultural region of the Bist Doab. Not only in irrigation and land use, this region registered significant change in its cropping pattern too. Wheat, rice, vegetables and groundnut gained significant area. At present these are its dominant crops. Maize, fodder and sugarcane are other notable crops of this region. It is the most urbanized and populated part of the Bist Doab. In contrast, the agricultural region covering the hills and the neighbouring dissected foothill plain is the least dynamic and least developed from agricultural and non-agricultural viewpoints. The increase in net irrigated and net cultivated area has been the minimal over here. It is the least irrigated region of the Bist Doab. The agricultural resource base too is the poorest over here. Its cropping pattern recorded sluggish change. Wheat captured area from wheat-gram. Rice could gain little due to limited development of irrigation and lighter soils. Raising of maize and wheat-gram on a considerable proportion of the total cropped area remained its dominant feature. It is the most problematic from the viewpoint of agricultural development. The agricultural region covering the flood plains lies in between the aforementioned regions, in terms of changes in and the existing patterns of agricultural land use. The development of irrigation here, has been slower than the upland
plain and faster than the submontane region. But the prospects for future extension of irrigation over here are the brightest mainly because of closer-to-surface sub-soil water and renewal of the same by seepage from river beds. This region has exhibited greater expansion of cultivation than the other two due largely to the control on floods and reduction in waterlogging. However, it lags behind the upland plain in existing agricultural resource base. It falls in between the other two regions in terms of quantum of change in the cropping pattern too. Rice showed the maximum increase whereas wheat could register limited expansion because of its already very high position in the crop complex of this region. These two crops occupy nearly three-fourths of the total cropped area and hence bring distinction to it as a wheat-rice region. No other region concentrates so heavily on these two crops. It is also transitional to the other two in overall agricultural development.

Distance plays an important role in the spatial organization of selected elements of agriculture. Its impact has been investigated in the context of city and its surrounding area; village settlement and its production territory and tube-well and its catchment area. The results clearly revealed that vegetable cultivation recorded higher increase and enjoys greater concentration in the villages located near towns than those located far away. Fodder too occupies greater concentration in the villages located near towns than those located far away. Fodder too occupies greater share of the cropland of
the villages located near urban centres. Demand of these commodities in the towns along with their perishable and bulky nature speaks for this. Distance from towns, however, does not play any role in the intensity of irrigation and cropping. The villages located near and far do not display any order in these regards. At the village level, distance affects neither the intensity of cultivation nor the location of crops. It is because the distances involved in travelling from the settlement to the fields are not very large due to moderate areal size of the villages. Whatever small role it was expected to play has been further diluted by the location of landholdings in consolidated blocks far and near the village settlements, due to which a farmer has no other option except to raise intensive and bulkier crops over there. Intense pressure of population and small size of farms which create a need to cultivate each bit of land as intensively as possible played its own role in subordinating the influence of distance. In the context of the source of irrigation and its catchment area, the role of distance in the location of crops is proved. More water demanding crops, such as clover and vegetables are grown near the tube-well, whereas the less water intensive ones are raised in the distant fields.

It needs to be discerned that although the Bist Doab recorded significant increase in irrigation, a lot is yet to be covered on this front. For achieving this goal, more and more canals should be extended particularly in the upland plain and minor irrigation
should be emphasized in the riverine tracts. The storing of rain water in artificial lakes and tanks and extension of a canal along the foot of hills may improve the situation in the foothill plain. Agricultural resource base in the Bist Doab has been stretched to its near limits. Very little potential lands are available for expansion of cultivation. And due to the acceleration of developmental activities, more and more good agricultural land is being pressed under non-agricultural uses. In the light of these trends, the land of the region needs to be used as rationally as possible. Secondly, farming should be intensified through multiple cropping and diversified by laying greater emphasis on dairy, poultry, piggery, fish farming, sericulture etc., to increase the farm production and the income of the farmers.

As mentioned earlier, higher emphasis on the selected crops like wheat and rice has enhanced farm incomes and specialization in cropping pattern. But it made the crop structure of the region more soil-exhaustive. Decline in cultivation of pulses and other leguminous crops which enhance the fertility of soil in a natural process, is likely to affect the health, both of the people and the soil. Thus, there is a strong need to diversify cropping pattern by exerting more stress on pulses, vegetables, fruit crops, oilseeds, sugarcane etc. Invention of high yielding seeds similar to wheat and rice in these crops and the creation of assured market for them will go a long way in achieving this aim. The future of the region no doubt lies in the diversification of agriculture and in the integrated agro-industrial development.