ABSTRACT

ENVIRONMENTAL IMPACT ON CHANGING CROPPING PATTERN IN ETAH DISTRICT

Agriculture in India dates back to the remote past, ever since it has continued to be the leading occupation and the mainstay of the people of the country. About three-fourths of the population of the country lives in the villages, carries out agricultural, and allied activities.

Primitive tillage farming in all parts of the world is, and in the past has always been, associated with a simple sequence of cropping. In the typical case a section of grass or light scrub-covered land is cleared and cropped with same or similar crops until it ceases to yield the profitable returns, either because of exhaustion of fertility or because of accumulation of weeds. In the former case, the cultivators move on and break up another virgin areas, in the latter case same practice may be adopted on a bare fallow or may be introduce to kill the weeds, after which the land is cropped as before. The former practice was probably adopted by in primitive times in India. As the needs of the community increases and farming become more intensive some definite sequence is adopted. Thus in the manorial period of this country “when each man had his rood of land” different cropping patterns were adopted. At the present time most of the farmers, when asked what rotation they adopt, will reply that they follow no fixed rotation, but at the same time, when further questioned, they will agree that they adhere to more or less closely to an orderly sequence which is capable of alternative application, as circumstances seem so warrant.

Before we are in position to appreciate the value of new cropping pattern, according to some agricultural economist, cropping pattern
means the proportion of area under various crops at a point of time. Quite often the area statistics are used to denote the cropping pattern, no doubt, farmers have evolved the present cropping patterns after centuries of experiences, may be better, but from the national point of view, it is not necessarily the most efficient use of land and other resources. Historically, these cropping pattern were based on the principle of self sufficiency in all commodities in a village where means of communication were very poor and dependence on marketing agency very much limited. Moreover, no cropping pattern can hold good for all times to come. It has to change with improvement in technology and economic factor.

Cropping pattern means both space and time sequence of crops. It includes the intensification of the most efficient crops of the region which is considered a homogenous soil and climatic characteristics, the rotation in which the crop fits in and the intensity of cropping. Thus the term cropping pattern is used in more comprehensive sense when we discuss in term of cropping pattern for farmers it will mean even cropping scheme and cropping intensity best suited to the farmers.

The importance of agriculture has been further underlined by the fact that the population of the country is increasing at a very fast rate, exerting a great pressure on land and adversely affecting the man-land ratio. As a result of cultivation of land over centuries, and as a result of increasing pressure of population on it, the chances of adversely affecting the land in particular and environment in general are also favourable. Thus there is a situation where the land has to be used with great care and where agriculture has to be evolved taking in to cognizance all the environmental and socio-economic factors. Only scientifically and intelligently, agricultural practices can meet the situation. This is possible only when the existing conditions, practices and the changes which are taking place are studied in a considerable
manner then this study in the district of Etah over the period of twenty five years could be more meaningful.

**STUDY REGION:**

The district of Etah lies in the central portion of the Ganga-Yamuna *doab*, and is bounded on the north by the Ganga which separate it from the Budaun district; on the west by the districts Aligarh, Mathura and Agra; on the south by the districts of Agra, Firozabad and Mainpuri; on the east by the district of Farrukhabad. The district lies between the parallels of 27°18' and 28°2' north latitudes, and 78° 11' and 79°17' east of longitude. The administrative configuration of the district Etah, as defined in the census of 1991, has been taken as the base for the present research work. The data taken from the district Etah is for the same administrative configuration as in 1991 census, throughout the period under study. This was necessary for making a comparative analysis of the change in the cropping pattern and environmental impact on it at the block level for the period under review. As per 1991 census, the administrative configuration of the district Etah comprised of five *tehsil* i.e. Etah, Kasganj, Patiali, Jalesar and Aliganj and fifteen development blocks i.e. Soron, Kasganj, Amanpur, Sahawar, Ganjdundwara, Patiali, Sirpura, Jalesar, Awagarh, Marehra, Nidhaul Kalan, Sheetalpur, Sakeet, Jaithra and Aliganj.

The district is subject to wide rainfall fluctuations from year to year and from season to season. Annual precipitation varies between 400 mm to 900 mm. It decreases from north east to south west directions. The average rainfall in the district during 1950 – 2000 was 700.5 mm. Better irrigation facilities and good alluvial soils bestowed the area with better opportunities for the high level agricultural development. Wheat-pearl millet and wheat-maize cropping system has emerged as the dominant agricultural system after the introduction of Green Revolution. Due to the fluctuations in rainfall and availability of fresh ground water
and well developed canal system, farmers depend on ground water for irrigation.

With a population of 2,244,998 as per 1991 census, district ranks 32nd among the districts of U.P. The economy of the district is based primarily on agricultural activities. The district's industrial base has remained agro-based. The main commercial activity of district is trade in grains.

**STATEMENT OF RESEARCH PROBLEMS:**

Crop production strategy followed in Post Green Revolution Period has considerably helped to expand food (cereal) output and their stocks in India. However, there are a number of other unfavourable trends in this progress that need attention to avert both complacency and deep crises. Serious doubts have been expressed in different quarters regarding suitable cropping pattern and technological progress. The strategy has made food production more unstable. Further, nearly 35 per cent of the rural people or 31 per cent of the overall population is still below the poverty line. The production of pulses and course grains is far from satisfactory. These unsatisfactory trends despite technological changes reflect that appropriate changes have not been made in the institutional and policy environment either before or after introducing technological changes. This does not mean that technological change should await appropriate institutional and policy environment change. The former may help bring about the latter and both should be pursued simultaneously. During Post Green Revolution period institutional changes like land reforms received low priority. The expansion of infrastructure like irrigation, drainage, transportation, market, rural electrification etc. was made mostly in developed regions (denying the expansion of the base of agriculture to the less developed, small and medium farmers). There is concentration of individual crops, of inputs and mechanization subsidies, positive price policies of crops grown in
developed regions and large farms. A considerable number of farmers (small and marginal), areas (resource deficient like unirrigated areas), people, mostly the agricultural labourers, crops and enterprises (coarse cereals, pulses, and oilseeds) were bypassed.

In order to account for the shifting of cropping pattern resulting from techno-organizational changes, a more dynamic conceptualization of changing cropping pattern is required. Such concept should capture the extent to which environment and economic changes are influencing the capacity of the farmers to various types of natural and socio-economic shocks. While the climatic changes may influence the biophysical vulnerability of Indian farmers, ongoing economic reforms may expose other type of vulnerabilities. With regard to agriculture, the main rational for economic reforms in India are to remove distortions and create an appropriate structure for increasing agricultural production. However, the short-term and medium-term impact of these reforms may not be exclusively beneficial. For consumers, increase in relative prices for food grains could worsen the conditions of the poorest in both rural and urban areas, exacerbating problems of food security for the most vulnerable sector of the population.

The effect of infrastructural development are also likely to vary across agriculture region in India; particularly irrigation technology, fertilizers and mechanical appliances. In areas, where investments in agricultural infrastructure have lagged, rates of growth in the agricultural productivity and poverty reduction also lagged. Climate change may further exacerbate these regional differences, because regions with limited irrigation infrastructure are also the areas where agriculture is most vulnerable to climate variability and change.

The problem that the author has studied is the change in agricultural land use. The major agricultural land use categories: fallow land, net sown area and gross sown area; keep on changing their
acreage. This has a direct bearing on agriculture. The locational change that takes place in these categories also has a bearing on agriculture. These changes, therefore, have been investigated in the district of Etah, and at six inter-decennial points of time.

**AIMS AND OBJECTIVES OF STUDY:**

The objective of the proposed research is a systematized and improved understanding of the dynamic forces which induced changes in the cropping patterns. Obviously, these forces broadly involve a dual effort: first defining the basic geography of change and its behavior in terms of rate of acceleration and deceleration, and, secondly, a search for the type's factors that have set discovered changes in motion. In very real sense, of course, individual crop in any agricultural region is in a state of essential competition with one another for the favour of farmer and for a place. However, some more objectives of the study are as follows:

1- To examine the dynamics and trends of crop land use and irrigated land in the Etah district.

2- To examine the spatio-temporal changes in the cropping pattern.

3- To bring out the spatio-temporal variations in agricultural land use efficiency.

4- To assess the levels of agricultural development with the help of selected indicators.

5- To assess the spatial patterns of agriculture and its level of modernization,

6- To suggest the suitable strategies for sustainable agricultural development.
HYPOTHESIS:

1- Spread of technology leads to the change in cropping pattern and cropping intensity.

2- Higher the level of irrigation facilities, leads to the higher the level of cropping intensity.

3- As the technological advancement goes on, the farmers turn from subsistence farming to commercial farming.

4- Through the technological advancement higher giving return crops prefer more and low return giving crops depressed e.g. coarse crops.

5- Higher level of agricultural development (unsustainable development), leads to higher level of environmental degradation.

DATABASE AND RESEARCH METHODOLOGY:

I- DATABASE:

The study is based on the analysis of statistical data covering the period during 1950-51 to 1965-66 for the analyses of cropping pattern, prior to the introduction of green revolution and post period during 1975 to 2000, collected from both primary and secondary sources at block and village level. The primary data were collected through well prepared questionnaire, taking in to account of all the variables related to agricultural development and cropping pattern. The village level information was collected from the selected respondents and Grampradhan (Village Head), Sarpanches and Gram Vikas Adhikaries (Village development officers) of the sample households and villages.
located in different soil characteristics and nearness to the roads and towns.

**a- SOURCES OF SECONDARY DATA:**

For the present study the secondary data has been obtained from the published literature, government reports and district statistical bulletins, daily and weekly news papers, and unpublished records of the public administration and semi-governmental agencies. The sources of secondary data utilized in the present study are listed in the following:

1. Survey of India Toposheets.
2. Census of India Statistics.
5. Village and Town Directories of District Etah.
6. District Census Hand Book of Etah.
8. Departmental District Head Office Records.
11. District Department of Revenue.

**II- METHODOLOGY:**

The qualitative and quantitative techniques have been used for the analyses of the present study which are as follows:

I- Descriptive approach has been adopted to describe the physico-cultural characteristics of the study area.
II- For the climatic description the moisture index has been calculated through the formula as under:

\[
\text{Moisture Index} = \frac{100S - 60Q}{PE}
\]

Where \( S \) = the surplus of water
\( Q \) = the deficit of water
\( PE \) = is water need or potential evapotranspiration which calculated on the basis of the following formula 3:

\[
e = 1.6 \left(\frac{10t}{I}\right)^a
\]

Where, \( e \) = monthly evapotranspiration
\( t \) = monthly temperature in °C.
\( I \) = summation of 12 monthly heat index \([(t / s)^{1.514}]\)
\( a = 0.00000675 I^3 + 0.00007711I^2 + 0.01792 I + 0.49239 \)

III- Ranking of crops is done by employing critical difference technique.

IV- Weaver's minimum deviation method has been used to find out the different crop combinations. On Formula as given below 4:

\[
d = \frac{d^2}{n}
\]

By calculating the deviation from the real percentage of crops for all possible combinations in the compound area units against theoretical values.
V- To work out the relation of changing cropping pattern and the irrigation facilities regression has been calculated as given below:

\[ Y = a + bx \]

VI- Techniques of composite Z score has been employed to determine the levels of the spread of green revolution and correlation between change in cropping pattern and the speed of green revolution technology.

Standard score (Z' Score), is represented by

\[ Z = \frac{X - \bar{X}}{SD} \]

- \( Z \) = Standard score
- \( X \) = original values of the score
- \( \bar{X} \) = Mean for all the values
- \( SD \) = Standard deviation of X

**LITERATURE REVIEW:**

The utilization of land for agriculture is conditioned not only on physical and biological factors but also upon the social, cultural and economic value of agricultural activities. Historically, the old world and new world agricultural activities differed probably resulting from the process of human migration (Grigg, 1974, 1992). More recently, a five pronged systematic approach uses the following criteria: location, ecology; social and cultural factors; technology; economic framework; physical structure and landscape (Avlan & Eder, 1986). A combination of
physical, biological and social factors combine together determine the

type of crop which is found in each system.

Scholars from various fields' viz., geography, agricultural
economics and ecology have shown a keen interest on the studies of
changing cropping pattern. The process and techniques involved in the
changing pattern of crop land use have been studied by many scholars
viz., Weaver (1954); Shafi (1965) and Singh(1976).Some geographers
have studied the implications of new technology in the changing
cropping pattern. Quite a few of them have also tried to study the
efficiency of agriculture in different areas viz., Mitra (1964); Pal (1962);
and Rao (1973). Shafi (1960) in his article has tried to measure the
agricultural productivity of great plain. Swafi 1991 studies; Relative
magnitude of impacts of crops on different components of the
environment, (1) Crop Erosion (risk and contribution), Nutrient loss
(leaching and run-off), Water use (soil moisture depletion), Nutrient
demand (impact on soil fertility status) and Pesticide use (impacts on
biodiversity and pollution). Batterbury, Forsth and Thomson have
studied in 1997 about Environmental Transformation in Developing
Countries: hybrid research and democratic policy.

Some researchers have studied the impact of globalization on
changing agriculture viz., Mwandire (environmental report 1999). The
broad assumption of this study is that environmental change and
degradation were already taking place in most parts of Malawi; Nsipe
included, but were accelerated by a combination of market liberalization
and other driving forces. The study carried out in Nsipe Extension
Planning Area (EPA) focused on smallholder agricultural production.
Environmental change in an agricultural setting was viewed as exhibiting
itself through land use and land cover change as well as increased levels
of chemical pollution in surface water bodies. The Nsipe EPA study
sought to provide an in-depth analysis of the environmental impacts of
cash cropping by small land holder farmers. One of the guiding assumptions of the introduction of cash crops among smallholder farmers, especially tobacco, was that there would be widespread environmental degradation. In order to counter this obvious impact an environmental monitoring program, known as the Malawi Environment Monitoring Program (MEMP) was put into place. The monitoring program described below sought to understand the environmental impacts of cash crop growing and in particular burley tobacco.

Laster Brown (2000) of the world watch institute have studied about an impending global food crises due to increasing population, increasing purchasing power leading to the more consumption of more animal products increasing damage to the ecological conditions of agriculture, declining per capita availability of land and water and absence of technologies that can further enhance the yield potential of major food crops. Swaminathan (2000) pointed out that India is now in a position to launch an ever green revolution that can help to increase yield, income, and livelihood per unit of land and water. If we bring about a paradigm shift in our agricultural research and development strategies. The green revolution was triggered by the genetic manipulation of yield in crops such as rice, wheat and maize. The ever green revolution will be triggered by farming system that can help the producers from the available land, water and labor resources with out either ecological or social harms.

Dinar et.al. (1998) have studied the net impact of climate change on agricultural output in India are uncertain, yet specific regions and certain groups of farmers, particularly those farming on marginal, rain fed lands, are likely to suffer significant damage as a result of climate change. Karen and Bien (1999) have studied the globalization is dramatically transforming the context under which farmers throughout the world participate in the agriculture sector. The changes, in turn,
A large number of studies have been conducted on the cropping pattern viz., Ali (1985) for higher return grow arher in intercropping system. Jyaraman and Ramiah, et. al. (1988) studies on nitrogen management in maize based intercropping system, Kushwaha (1985) effect of fertilizers on yields of mustered and lentil in intercropping system, Saxena, and Chandel (1986) effect of maize on physico-agronomic attributes of soybean in maize-soybean intercropping system, Singh, Mittal, et.al., (1983) have studies on depletion pattern of soils potassium in pearl millets, wheat rotation.

**ORGANIZATION OF STUDY:**

The study is thematically organized in to nine chapters. The first chapter is introductory and acquaints the reader with the nature of the research problems, study area, aims and objectives of the study, the hypothesis, data source and research design. The geographical profile of the study area and covering its natural environment is the concern of second chapter. The third chapter represents the background of the cropping pattern before the introduction of green revolution, since 1951. The fourth chapter deals with change in the cropping pattern after the introduction of green revolution at block level, from 1975 to 2000. Various problems arise due to the introduction of green revolution examine in the fifth chapter. Chapter six and seven presents an account of the place of the coarse grains in the cropping pattern and level of diffusion of green revolution at block level in the district of Etah. The chapter is based on inferences drown from the micro level study i.e. at village level, which covers farming characteristics, present cropping pattern and techno-organizational environment of the villages.
selected for the study. The ninth and final chapter presents conclusions and puts forward suggestions.

**FINDINGS:**

Landforms, drainage, soil, climate is the basic environmental factors which sometime separately and sometimes togetherness determines the cropping pattern in the district. But in the present scientifically advanced world there are no necessities everywhere are possibilities, it means man through his technical skills break the natural barriers through the development of irrigation facilities, mechanical appliances, use of fertilizers, recovering of sodic or usar land, etc.

The district Etah is one of the most fertile districts of Uttar Pradesh where the new technology of agricultural development was initially introduced in 1970. Since then this district has undergone tremendous changes in the field of agriculture. There has been an increase of net sown area from 302495 hectare in 1975 to 310713 hectare in 1999-2000, Gross cropped area from 446857 hectare to 534051 hectare gross irrigated area from 273202 hectare in 1975 to 412719 hectare in 2000. Fertilizers consumption (NPK) has increased from 23.73 kg per hectare in 1975 to 128 kg, per hectares in 2000. The shallow pump sets per thousands of hectares of net sown area have increased from 36 in 1975 to 215.9 in 2000. The numbers of tractors have gone up to 2.73 per thousand of hectare and 12.6 in 2000. These figures convincingly make Etah district one of the most agriculturally progressing districts of Uttar Pradesh. However, the cropping pattern has not been uniform throughout the district. Hence a modest attempt has been made to assess the changing cropping pattern of the Etah district at the block level for the years of 1975-2000.

The trends in the land use is that more and more land is brought under the plough, more forest land, pasture and grazing land is being
deprived of its vegetative cover. More land is coming indiscriminately under industries and urban activities. Another trend is that with the rise of technological and scientific level of development, those lands which were considered useless are being reclaimed and being brought under agriculture. Soils which were considered unfit are enriched and are ploughed.

The present study has been one of the probing in to dynamic competitive relations of crops in the total crop land since the approach has been through analysing individual crops and crop combination in terms of their relative land occupancy strength. An analysis of the data shows that from time to time changes have taken place in the cropping pattern of the area due to one or the other factors the study spread into two phase i.e. before the introduction of green revolution and after the introduction of green revolution, has established some definite lines of approach to the present cropping patterns which have evolved during the period under study. In many cases, it has been observed that change has been brought about by economic consideration, e.g. low return giving crops (coarse grain crops) replaced by high return giving crops wheat, rice and sugarcane in the area where irrigation facilities are available. It has been observed that in the district Etah the number of crops included in the combination is fairly large and the cropland use diversity quite high.

The present study relating to the changing pattern of crop land use over a period 1950-65 and 1975 to 2000 reveals that wheat has emerged as the first ranking crop in the whole of the district of Etah. This crop has a good share in the combination of area. As it is the staple food crop of not only of the district Etah but whole of the western Uttar Pradesh. Majority of the population prefers to eat wheat with the result the area under wheat has increased gradually. Yield per hectare has also increased with the help of irrigation facilities, and chemical fertilizers.
Prior to introduction of green revolution, more area was given to millets and gram in the district but with the improved economic conditions of the forming community, wheat being a better food crop has become the main diet of the majority of the population. Data reveals that oil seeds, pulses, tobacco, potatoes gained importance in the period after introduction of green revolution, and for the first time tobacco ranked third in the development block of Aliganj. This development block has very much specialized in the cultivation of tobacco fetching good returns.

According to the present study, maize crop is becoming an important crop in the block of Jaithra, Marehra, Patiali, Sirpura, Sheetalpur and Soron, developed irrigation facilities, improvement in the regular supply of manure and chemical fertilizers have helped in the increase of maize cultivation. The increasing market value of superior quality of maize has also been responsible for increase in the cultivated area of maize. Pearl millet remains the second raking crop in most of the development block, Kasganj, Jaithra, Aliganj, Jalesar, Patiali, Soron, Marehra and Nidhaulikalan, due to the quality of soil i.e. Sandy soil. Adequate irrigation facilities and attracting market values provide incentives for increase in the cultivated area. The cultivated area of rice has increase in the development block of Sakeet, Amanpur, Jalesar, Ganjdundwara, Patiali, Sirpura and Sheetalpur, present reveals that rapid rise in urban population in the district Etah calls for an increase in the production of wheat, rice, maize, peas, barley and oil seeds, but wheat has got ascendancy over all the other crops since 1970 because the introduction of high yielding varieties of this crop and the development of supporting factors i.e. irrigation, mechanical appliances and fertilizer which help to mature in a very short period with high production per hectare. One important thing to note here is that the sugarcane acreage decreasing day by day since 1990 because of the delay of payments by the factory owners. Tobacco has not been so
important crop in the cropping pattern of the district Etah but the development block of Aliganj have third rank in its cropping pattern.

An interesting feature emerges from the present study is that the size of land holding being small the farmers are generally interested in producing food grains for their requirements. They would go in for cash crops only after they met their requirements of food grains. It is true that the agriculture of the district Etah being of subsistence type the farmer's community first concern is to cultivate grain crops than cash crops. Thus the need for subsistence crops has traditionally dominated the cropping pattern fallowed by small farmers. But his marginal need for money can not be less than that of the large farmers. The introductions of green revolution technology make easy marginal adjustment in their crop pattern to maximise their income.

The fragmented and uneconomic size of land holding have brought about just agriculture deterioration at the same time have aggravated poverty of formers. Another drawback in the small size of land holding is that it initiate against the use of form machinery e.g. harvester etc. from the present study it is gathered that the farmers like that the combination of crops which would ensure him maximum income. The relative profitability per hectare is the main consideration which influences the cropping pattern. So the farmer is influenced in the choice of his crops by the consideration which relates to the price parities between different commodities or maximization income per hectare which in turn effect to the coarse gains.

It has been realized that the presence of saline salt in soil affect the cropping pattern in the region to a considerable extent. If some steps are taken to grow leguminous crops, these crops then will help in neutralising the salt and in the recuperation of soil fertility. Reclamation work should be undertaken by the govt. agencies.
Another factor which requires some consideration is that the soils in the entire region are generally deficient in nitrogen and therefore besides applying nitrogen through chemical manures some leguminous crops, which instead of depleting soil fertility, help in increasing nitrogen in sufficient quantity. In addition to this sun hemp and *Dhencha* are the two important crops which can be cultivated in all adverse conditions of soil and climate.

The structure of cropping pattern in whole of Uttar Pradesh in general and in the district Etah in particular is based on adopting trial and error methods, and hence unscientific. In the present set of physical and cultural environment, some suitable areas for cultivation of remunerative crops could be explored. Besides multiple cropping systems under proper guidance of agricultural experts can be adopted. At least four crops such as wheat, green gram, maize and potato can be grown in a year from one field. Although the multiple cropping systems are exhaustive, proper watering and manuring can make it possible.

Examining the various factors influencing cropping pattern, it has been observed that besides the physical and socio economic factors, have greatly influenced the cropping pattern in the area where least consideration in given to the suitability of the soil for a particular crop. In the light of the present study it may be remarked that the area needs a detailed survey of the soil, so that the new cropping pattern could be evolved which may ensure better prospects for an overall improvement in the agricultural economy of the area.