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A Study On Agriculture Land Use In Muzaffarnagar District Of Uttar Pradesh

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Abstract

For agriculture, the land is the most vital resource of a country. It is a fixed asset and cannot be expanded to meet the needs of an increasing population. Therefore, agricultural land must be used carefully in the best possible manner. Agriculture is a predominant emphasis to economic activity of India, engaging nearly three-fifths of its working population. Obviously, it forms the hub of Indian economy as large numbers of industries are also heavily dependent on agriculture for supply of raw material. In the present study, an attempt has been made to analyse the agriculture landuseand its cropping pattern in Muzaffarnagar district ofIndo-Gangetic plainof Uttar Pradesh using secondary data from various secondary records.A simple statistical method has been used with the help of Weaver's technique of crops combination.Muzaffarnagar district of Uttar Pradesh is located at western part of Uttar Pradesh with an area of 4008 sq km and its total population of 4143512(Dist Census Handbook 2011). The climate of Muzaffarnagar district may be described in four seasons: winter (Jan-Feb), summer (Mar-May), rainy (Jun-Sep) and post monsoon (Oct-Dec). Muzaffarnagar district has recorded max 40.0 ºC-45.0ºC and min 3.0 ºC-5.0ºC degree Celsius temperature.The normal rainfall goes around 753 mm to 1159 mm (Muzaffarnagar Wikipedia).The major crops like wheat, paddy, sugarcaneand oilseeds in the district is higher as compare to the state average productivity. By computing crop ranks, Muzaffarnagar district has been identifiedwith ten crops combinations. Physiographic elements, soil textures, drainage patterns, socio-economic factors, advanced science and technology, climate including temperature, rainfall and humidity influence on agriculture land use and cropping pattern in the study area Muzaffarnagar district of Uttar Pradesh. Research in agriculture is basically required to make innovative ideas for growth and development of agriculture sector, so that productions of agriculture inputs are made.Finally, this study will definitely encourage target group of people including policy makers, planners, agriculture scientists and research scholars in pursing further studies in their respective field of expertise.

Keywords: Agriculture land use, cropping pattern, Muzaffarnagar district, Uttar Pradesh.

Introduction

The agricultural land in India is little more than 50 percent of the total geographical area in the country. But due to large size of population in India, per capita arable land is available only 0.17 hectares which is lower than world average (0.24 hectares).The per capita agricultural land in some of the selected countries are much higher than India like Australia(2.8hec),Canada(1.35 hec) and Brazil(0.35 hec).

Agriculture is the country's economic mainstay that provides basic human needs and its existence.The important of agriculture sector is very essential due to its peculiar production charecteristics and consumption system related to the agricultural output. Agriculture contributes a large share of net domestic product of Indian economy and the agricultureland use is the result of the direct application of efforts applied to decision made by the farmers regarding the actual use of land.

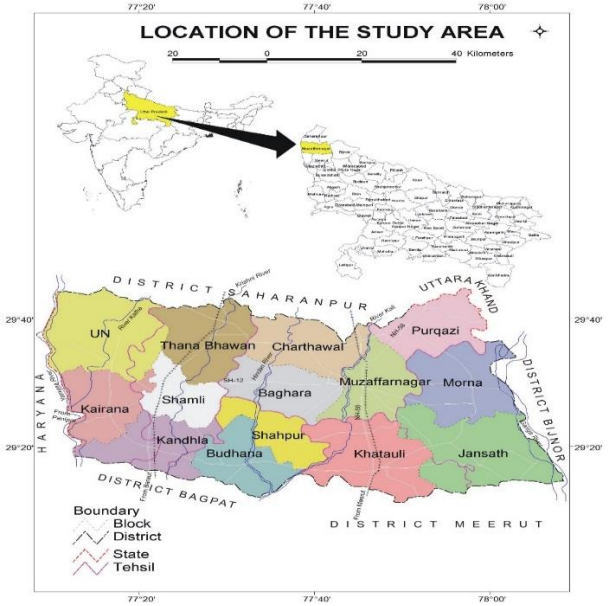
The net sown area, current fallows and land under tree crops and groves are included in agricultural landuse. The lower the capita availability of land is an indicator of higher pressure of population on land resources.Since there is a little scope for increasing land under the plough,the way over to feed the growing population can be found in increasing land productivity.Over the period,area sown more than once has been increasing in Muzaffarnagar district and Uttar Pradesh in general.Consequently, the need of cultivate more and more of our rapidly shrinking per capita land resources has become important. Hence, farmers are growing numerous of crops in the field rather than single crop.

The resources is becoming dependent at an increase rate due to soil erosion, soil salinity,alkalinity,water logging, soil pollution, chemical and toxic industrial wastes. The shrinking of agriculture land and demand for more food production calls for double and multiple cropping patterns in a single piece of land. There is a need to pay more attention to better management of agricultural landuse and agricultural system, especially cropping pattern. The distributional pattern of the crops in any region is an outcome of its predominance of certain crops or combination of crops. On consequence, it has been observed that agricultural landuse and cropping pattern has undergone a sea changed evolutionary process in the study region.

Study Area

The study area chosen represent a true agricultural area, as it is characterised by 70% workers in agriculture, 80% of land under cultivation and an insignificant 2% land covered by forest (Sankhyaki Patrika, 2011).

Fig 1: Location map of the study area Muzaffarnagar District, UP.



Muzaffarnagar district is located on the western boarder of the State. It is roughly rectangular in shape. The district is situated in the doab of the Ganga and the Yamuna between the districts Saharanpur on the north and Meerut, Bhagpat on the south. On the west the Yamuna separates it from the district of Karnal of Haryana state, and on the east the Ganga forms the boundary between the districts of Bijnor. Muzaffarnagar district is lying between north latitudes 29^0 11'N and 29^0 43'N and east longitudes 77^0 04'E and 78º07'E. The extreme length from east to west is about 98 km while extreme length from north to south is about 58 km. The average length and breadth are 84 km and 50 km respectively. The height of the district from the mean sea level (MSL) is 273 metres. The area of the district is 4008 sq km. The district is subject to fluvial action of the Ganga and Yamuna giving rise to frequent changes in its area.

Weather and Climate

A humid temperature climate is found across Uttar Pradesh.The temperature of the state varies between 0ºC and 50º C and the mean annual rainfall ranges from 650mm in south west corner of the state to 1000mm in the eastern and south eastern part of the state.The climate of Muzaffarnagar district is healthy. The maximum and the minimum temperature in the district were recorded 40.0 ºC - 45.0ºC and 3.0 ºC - 5.0ºC degrees Celsius respectively. The rains largely occur during monsoon season. Winter rains are very low in the district. The normal rainfall was recorded in the district. The air is very humid during the monsoon season.

Table1: Muzaffarnagar District: Weather Data (Rainfall, Temperature and Relative Humidity

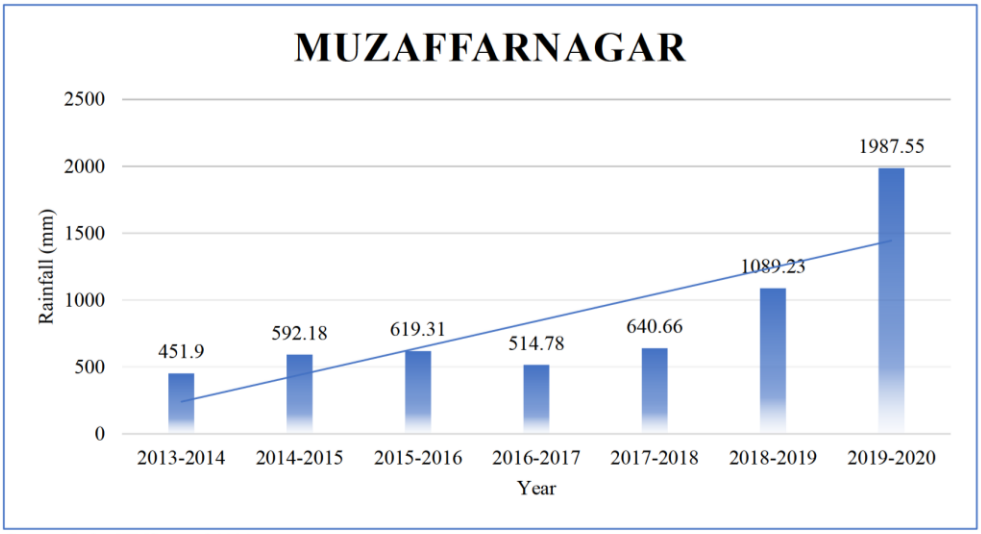
Month	Rainfall(mm)	Temperature (ºC)	Relative Humidity (%)
April 2014	1.7	Maximum: 34.3 Minimum: 17.5	41.1
May 2014	37.8	Maximum: 38.7 Minimum: 21.8	40.5
June 2014	21.2	Maximum:33.7 Minimum:23.4	72.0
July 2014	210.8	Maximum:32.6 Minimum:24.3	82.5
August 2014	107.4	Maximum: 32.3 Minimum:23.4	80.0
September 2014	74.3	Maximum: 33.1 Minimum:22.0	73.0
October 2014	0.27	Maximum: 31.83 Minimum:19.14	
November 2014	0.08	Maximum: 28.25 Minimum:11.38	
December 2014	17.6	Maximum:20.0 Minimum:5.4	
January 2015	27.2	Maximum:16.5 Minimum:7.6	
February 2015	0.42	Maximum: 25.62 Minimum:13.28	
March 2015	3.00	Maximum: 27.38 Minimum:14.79	

Source: KVK, Muzaffarnagar (2014-15)

Table 2: Rainfall Muzaffarnagar District

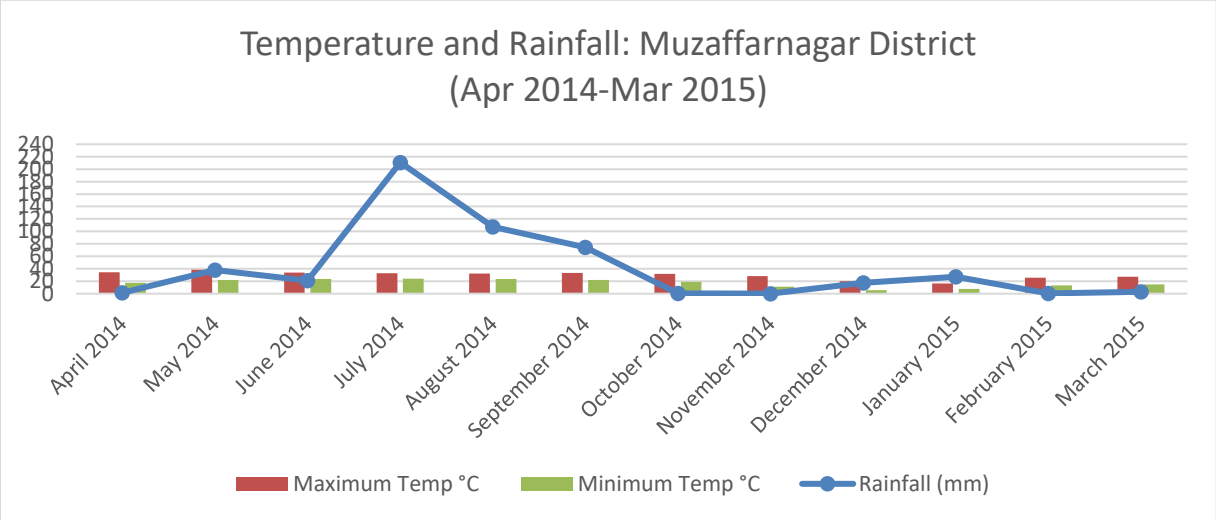
District	Normal (mm)	2018-2019 (mm)	2017-2018 (mm)	2016-2017 (mm)	2015-2016 (mm)	2014-2015 (mm)	2013-2014 (mm)
MUZAFFARNAGAR	833.7	1089.23	640.66	514.78	619.31	592.18	451.9

Fig 2: Rainfall Trend: Muzaffarnagar District



Source: India WRIS portal,2020

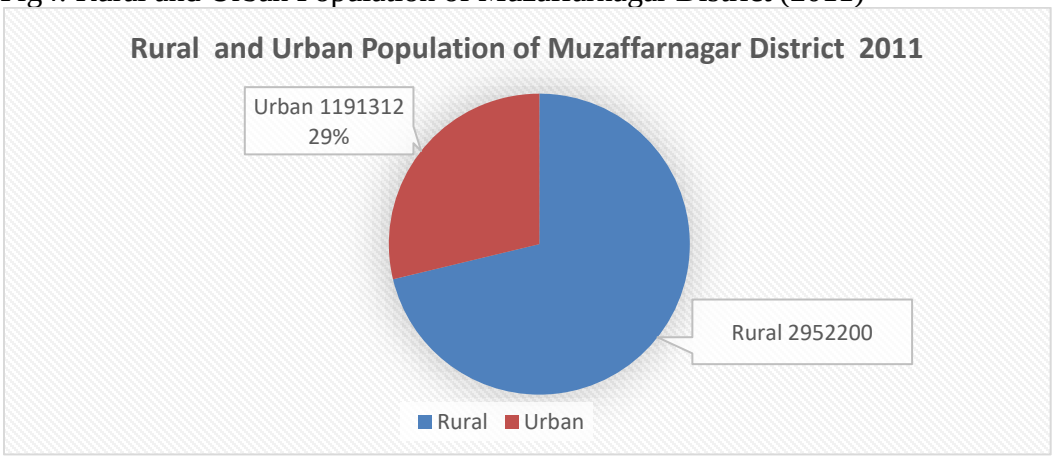
Fig 3: Temperature and Rainfall: Muzaffarnagar District (2014-15)



The climate of Muzaffarnagar district may be described in four seasons: winter (Jan-Feb), summer (Mar-May), rainy (Jun-Sep) and post monsoon (Oct-Dec).

Population (Rural and Urban)
As per Census 2011, the population of Uttar Pradesh was 199812341 which 77.72 percent lived in rural areas followed by 22.28 percent in urban areas where as the population of Muzaffarnagar district was4143512 which71.2 percent lived in rural areas followed by 28.8percent in urban areas.

Fig4: Rural and Urban Population of Muzaffarnagar District (2011)



Source: Census of India 2011, Provisional Total-2011(2011)

Muzaffarnagar district has 6 Tehsils, 14 Blocks, 6 Municipalities, 27 Town areas (20 statutory towns and 7 census towns). There are 1019 villages in Muzaffarnagar District of Uttar Pradesh.

Objectives: An attempt has been made to analyses the agriculture land use and cropping pattern of Muzaffarnagar district in Indo-Gangetic plain of Uttar Pradesh.

Database and Methodology: Present study mostly relies on the secondary data collected from Directorate of Agriculture, Govt of UP, Dist Statistical Dept of Muzaffarnagar, KVK Muzaffarnagar, Dist Census Hand book 2001 and 2011,Dist Socio-economic abstract of Muzaffarnagar District ,Govt of UP Statistical Diary,Economic&StatisticsDivision,State Planning Institute,www.agriculture.up.nic.in,www.upmandiparisa.in, www.agricrop.nic.in, www.aps.dac.gov.in,www.hq.nasa.gov,From the investigation point of view, Muzaffarnagar District and its tehsils are selected for the study with reference to Uttar Pradesh.
For the study of agriculture landuse and cropping pattern various methods have been used by scholars, agriculture scientists and geographers. Among them, a simple statistical Weaver's method is selected in present investigation. Weaver in 1954 has applied least standard deviation technique for computing crop combination region. He demarcated agricultural regions applying statistical method on the basis of percentage of crops and their associations. According to them, crops always exist in association. His formulation has been a simple one. First, the percentage of each crop of the selected crops to the total cropped area is determined. Then each percentage is considered against a standard norm and with the help of standard deviation the right crop combination is determined.

Concept of Agriculture land use
All ecosystems modified or created by man,especially to grow or raise biological products for human consumption or use.That includes crops

land,pasture,orchards,groves,vineyards,nurseries,ornamental horticultural areas,and confined feeding areas.Agriculture land use means land under net sown area, forest, current fallow and uncultivable land, other fallow land, cultivated waste, permanent pasture and grazing land. The cultivated area is known as a cropping pattern. Cropping pattern is defined as the statistical representation of crops rotations, or as the list of crops that are being produced in an area or their sequences in time. Hence, it refers to the proportion of land under cultivation of different crops at different point of time. This indicates the time and arrange of crops in a particular land area(https://www.hq.nasa.gov).

In short, agriculture land use means a cropping pattern. A cropping pattern means the proportion of area under various crops at a point of time or yearly sequence and spatial arrangement of crops and current fallow on a given area. Cropping pattern is a dynamic concept as it changes over space and time. The cropspatterns of a region are closely influenced by its surrounding geo-climatic, socio-cultural, economic,historical and political factors.

Need of Agriculture land use study

Agriculture has been a part of human life since the beginning of human race. Agriculture is the principal means of live hood for majority population of India. About 70 percent of workforce is engaged on agriculture pursuits. It remains the largest economic sector in India. It is the backbone of the country's economy system. It is the main source of income of people living in rural areas. In addition to providing food and raw material, agriculture also creates job opportunitiesto a very large percentage of people. One third of our national income comes from agriculture. India is a agriculture based country, where farmers contribute to a remarkable portion of Indian economy. The First- Five -Year plan (1951-56) in India was focused primarily on the development of the primary sector, especially agriculture and irrigation. Special attention was paid to development of an agriculture research infrastructure immediately after independence.

Agriculture land use and land management practices have a major role on natural resources including water,soil,nutrients,plants and animals.Landuse information can be used to develop solution for natural resource management issues such as salinity and water wasting. A lot of research and experiments are being conducted by the scientists of our country to improve the standard of level in various agricultural and allied fields. In a nutshell, need of agricultural landuse is basically (i) to feed the human's requirement, (ii) to derive solution for landuse problem, (iii) to maintain socio and ecological balance, (iv)finally,optimum and best use of land.

Land use

The major land uses/land cover in the study region is charectarised by agriculture, forests, horticultural plantations, barren rocks, scrubs,settlements,wastelands and water bodies.The total geographical area of the state was 24170 thousand hectares of which 68.64 percentage under cultivation where as total geographical area of Muzaffarnagar district was 421.473 thousand hectares of which 77.56 percent under cultivation.Of the total reporting area of Uttar Pradesh and Muzaffarnagar district,land put to non-agricultural use accounted for maximum share being 11.73 percent and 11.86 percentage respectively, followed by forest (6.86%) in Uttar Pradesh and (6.57%) in Muzaffarnagar district.Barren uncultivable land (2.01%) was in Uttar Pradesh where as in Muzaffarnagar district barren uncultivable land recorded (1.01%).The land put to non-agricultural use and net area sown is quite similar in both the cases.Muzaffarnagar district contributes 11.86 percent non-agricultural land and 88.14 percent net area sown as compare to Uttar Pradesh i.e. 11.73 percent and 88.27 percent respectively.Current fallow area and permanent

fallow area in Muzaffarnagar district (1.21%) and (0.60%) is much lower than the state report (5.03%) and (2.23%).But the cultivable land in Muzaffarnagar district (77.56%) is higher than state cultivable land (68.64%).A comparative figure of Muzaffarnagar district and Uttar Pradesh for 2011-12refers that the forest cover exist 6.57% in Muzaffarnagar district which is slightly lower than the state (6.88%) recorded.

The percentage of net area sown to reporting area of Uttar Pradesh and Muzaffarnagar district has been decreasing continuously due to fast expansion of industrialization and urbanization in the state.

Land utilization is the term used to describe the human uses of land. Land utilization in Muzaffarnagar District and Uttar Pradesh are taken into account in the present study. (Fig 7 and table 3)

Fig 5: Land Use –Uttar Pradesh in Percentage

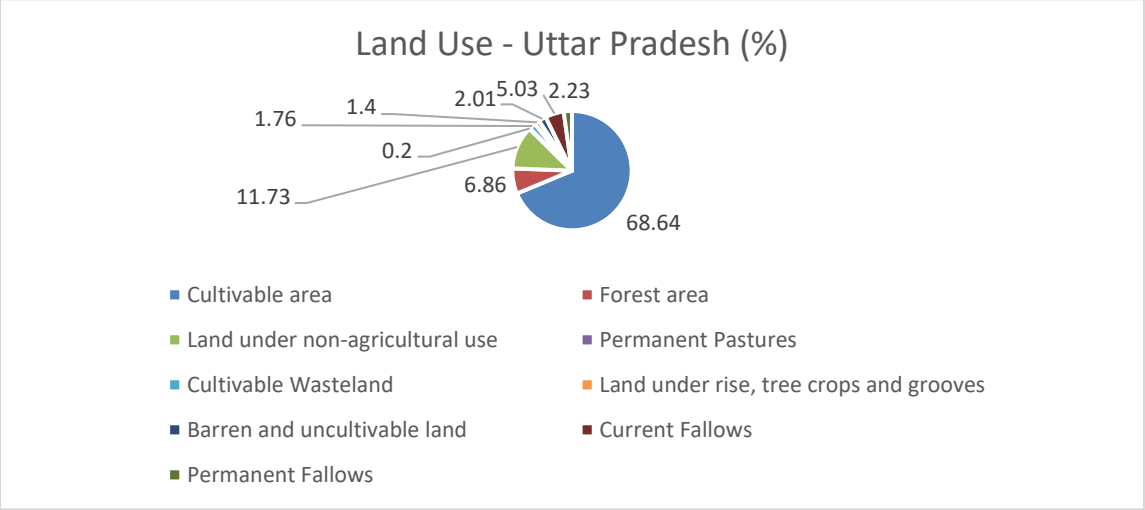


Fig 6: Land Use –Muzaffarnagar District in Percentage

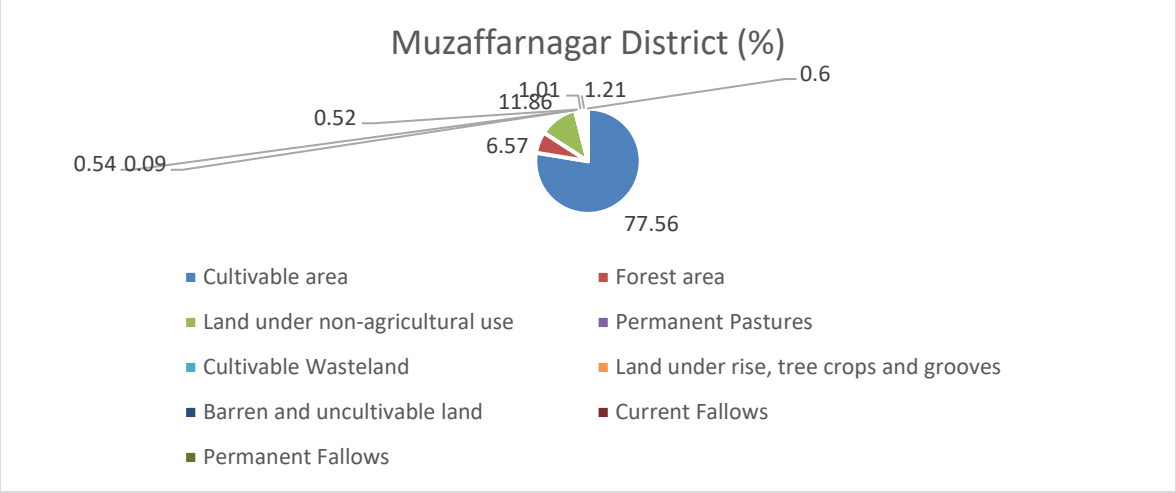


Table 2:Land Utilisations in Muzaffarnagar District and Uttar Pradesh

Land use pattern of the district (Muzaffarnagar District)	Geographical area	Cultivable area	Forest area	Land under non-agricultural use	Permanent pastures	Cultivable waste land	Land under Misc. tree crops and groves	Barren and unculti vable land	Current fallows	Other fallow
Area('000 ha)	421.473	326.920	27.707	50.003	0.385	2.314	2.207	4.271	5.122	2.544
%	100	77.56	6.57	11.86	0.09	0.54	0.52	1.01	1.21	0.60

Land use pattern of the district (Uttar Pradesh)	Geographical area	Cultivable area	Forest area	Land under non-agricultural use	Permanent pastures	Cultivable wasteland	Land under Misc. tree crops and groves	Barren and unculti vable land	Current fallows	Other fallow
Area('000 ha)	24170	1659	1658	2835	66	426	354	486	1215	538
%	100	68.64	6.86	11.73	0.2	1.76	1.4	2.01	5.03	2.23

Source: agricrop.nic.in/agriculture contingency/UP-2012 and Statistical Diary, Government of UP 2011-12

Forest Density Classification

According to the Indian States Forest Report(ISFR) 2019,the total recorded forest area in Uttar Pradesh is 6.88% of the total geographical area of the state.The total forest covered area in the state is 16582 sq km in term of forest canopy density classification.The state has 2617 sq km under Very Dense Forest(VDF),4069 sq km under Moderate Dense Forest(MDF) and 7993 sq km under Open Forest(OF).Forest Density Classification of Muzaffarnagar district(2019) recorded total Moderate Dense Forest (MDF) 0.31 percent and Open Forest (OF) 1.47 percent combined together share 1.65 percentage of geographical area of Muzaffarnagar district.

Fig 7: Showing Forest Area Classification of Muzaffarnagar District (2019)

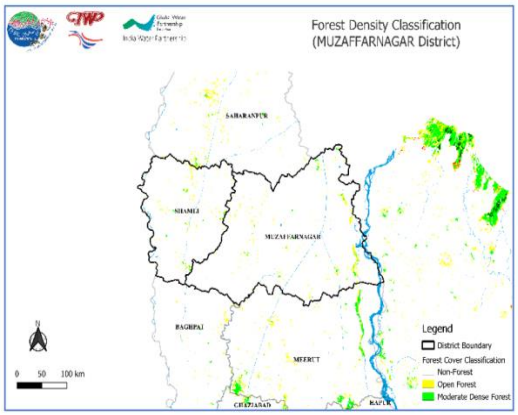


Figure 45 Forest Density Classification (Map)

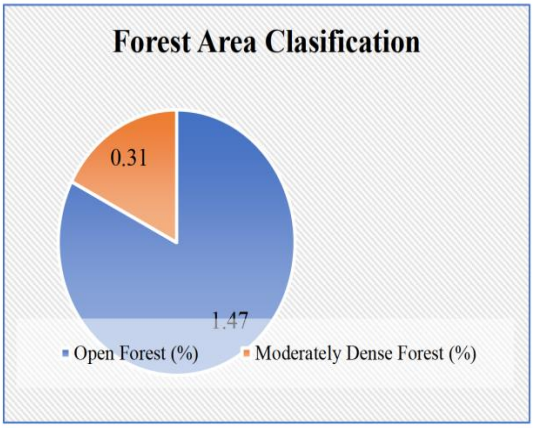


Figure 46 Forest Area Classification (Graph)

Table 70 Forest Density Classification: Muzaffarnagar

District	No Data (%)	Water Bodies (%)	Non Forest (%)	Scrub (%)	Open Forest (%)	Moderately Dense Forest (%)	% of Forest w.r.t. Geographical Area of District	% Change in Forest Cover w.r.t. 2017
Muzaffarnagar	0.00	0.79	97.45	0	1.46	0.31	1.65	26.11

Source: India State of Forest Report, Forest Survey of India, 2019

Operational Land Holdings

The distribution of size of holding is very much uneven in the state and in Muzaffarnagar district.Out of total operational holdings of 22939348 thousand (Uttar Pradesh), the marginal holding accounts for 79.20% followed by small holdings 13.14%, medium holdings 7.51% and 0.15% large holdings respectively during 2010-11(Table 4).In case of Muzaffarnagar district, similar characteristics are found with total land holdings211365 thousand, the marginal holdings for 27.85%, followed by small holdings 23.79%, medium holdings 45.94% and large holdings 2.4% during that same period (Fig 8,9 and Table 5).

Table 4: Operational Land Holding Records of Uttar Pradesh

Sl. No	Size of Agricultural Land	No. of Holdings	Area
1	Large(more than 10 ha)	35430	381810
2	Medium (2-10 ha)	1723212	5796184
3	Small (1-2 ha)	3013634	4200335
4	Marginal (Less than 1 ha)	18167072	6710629
5	Total	22939348	17088960

Source: Agricultural Statistics at a glance 2012 Govt. of India

Table 5: Operationaland Holding Records of Muzaffarnagar District

Sl. No	Size of Agricultural Land	No. of Holdings	Area

1	Large(more than 10 ha)	298	5369
2	Medium (2-10 ha)	29854	102385
3	Small (1-2 ha)	34584	53016
4	Marginal (Less than 1 ha)	146629	62079
5	Total	211365	222849

Source:KVK,Muzaffarnagar(2013-14)

Fig 8:Showing distributon of total agricultural land (area) of Muzaffarnagar District UP.

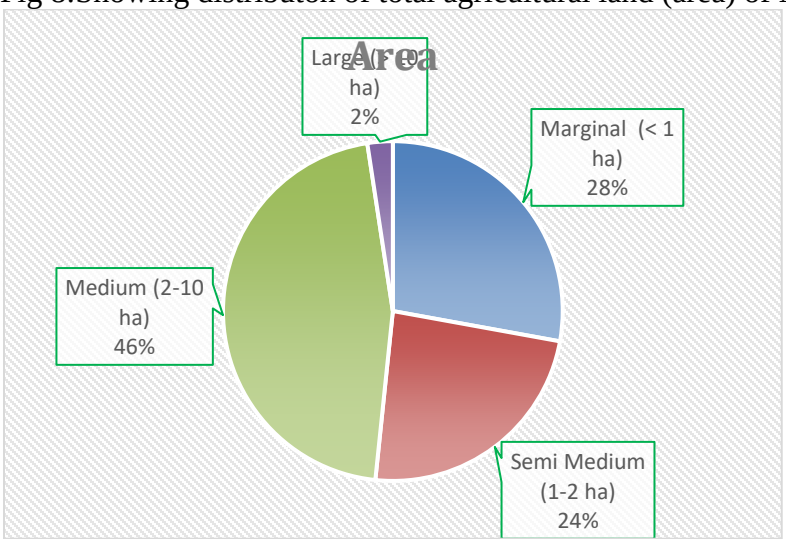


Fig 9:Showing distributon of land holding of agricultural land (area) of Muzaffarnagar District,UP

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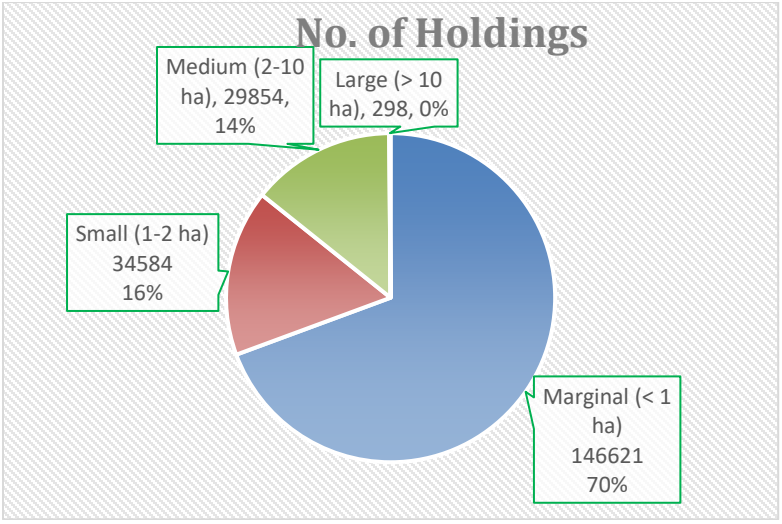
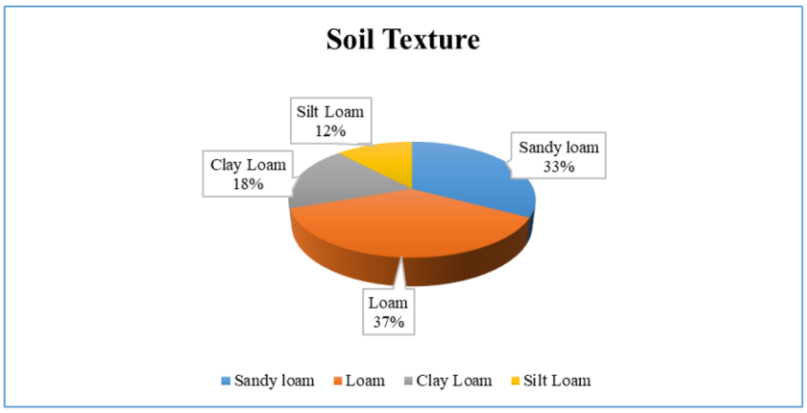


Soil Texture

Soil texture (such as sandy loam, loam, clay loam, silt loam) refers to the proportion of sand, silt and clay sized particles that make up the mineral fraction of the soil. The important of soil texture is its role in managing the nutrition value plants received.

Fig 10: Soil Texture ofof Muzaffarnagar District of Uttar Pradesh

Soil Texture



Soil Texture (Graph)

Soil Texture Statistics: Muzaffarnagar

District	Sandy Loam (Thousand Hectares)	Loam (Thousand Hectares)	Clay Loam (Thousand Hectares)	Silt Loam (Thousand Hectares)
Muzaffarnagar	106.32	119.59	59.27	39.23

Source:http://agricoop.nic.in/agriculturecontingency/Uttar- Pradesh, 2012

Table 6:Soil Texture:Muzaffarnagar District of Uttar Pradesh

Major Soils	Area('000 ha)	Percent(%) of total
1.Sandy Loam	106.32	32.55
2.Loam	119.59	36.58
3.Clay Loam	59.27	18.13
4.Silt Loam	39.23	12.00

Source: agricrop.nic.in/agriculture contingency/UP-2012

Water

Water is the gift of the nature.Rainfall is the main source of water resource.Uttar Pradesh is much fortunate to get better rainfall in comparison to most of the states of the country.Water resource of the state is classified into two groups,namely-Surface water resource and Ground water resource.The availability of ground water in Uttar Pradesh was 68575 million cubic metre of which 72.18 percent has been utilised upto March 2009.

Irrigation by Different Sources

The following major irrigation and multi purpose projects have been constructed in Uttar Pradesh to provide the better supply of surface water through canals.

I.Sarda Sahayak,II.Ramganga,III. Gandak Project(U.P. & Bihar). Irrigation network in the district of Muzaffarnagar is very rich. The main source is tube well and canal. The private tube wells in the district were more popular than government tube wells and canals. Yet, another indicator chosen for identifying the levels of development is the irrigated land. Rural development is largely dependent on agricultural development upon the availability of irrigated land. Irrigated land, in

fact, constitutes the basic infrastructure including adoption of necessary modern agricultural technology for its agricultural development in a county. Irrigation is also essential for the
The tube wells and canals are main sources of irrigation in Uttar Pradesh and Muzaffarnagar district. Out of total net irrigated area, being 13440 thousand hectares,71.50% area was irrigated but tube wells followed by 18.90%,8.6%,0.8% by canals,wells and ponds in Uttar Pradesh respectively during 2011-12.In Muzaffarnagar district, out of total net irrigated area being 325.543 thousand hectares, 76.65% area was irrigated but tube wells(Govt.& Private) followed by 21.8%,1.07%,0.01% by canals, wells and ponds in Muzaffarnagar district respectively during that same period.

Table 7: Agriculture land use and cropping intensity (%) of Muzaffarnagar District and Uttar Pradesh

Agriculture land use	**Area('000 ha)**		**Cropping intensity* (%) 2011-12**	
	Muzaffarnagar Dist	**UP**	**Muzaffarnagar Dist**	**UP**
Net sown area	326.920	16593	144.08 %	155.60%
Area sown more than once	144.118	9022		
Gross cropped area	473.038	25615		

Source: agricrop.nic.in/agriculture contingency/UP-2012 & Directorate of Agriculture,UP.
*Agriculture land use intensity as the degree of adoption of land management process enabling yield increases from a given area of agricultural land.

Table 8: Irrigation Areas in Muzaffarnagar District and Uttar Pradesh

Irrigation	**Area('000 ha)**	
	Muzaffarnagar Dist	**UP**
Net irrigated area	325.453	13440
Gross irrigated area	466.916	19628

Source: agricrop.nic.in/agriculture contingency/UP-2012 & Statistical Dairy 2012, Govt of UP.

Table 9: Sourcesof Irrigation in Muzaffarnagar District and Uttar Pradesh

Sources of Irrigation	**Area('000 ha)**		**Percent(%) of total irrigated area**	
	Muzaffarnagar Dist	**UP**	**Muzaffarnagar Dist**	**UP**
Canals	71.320	2539	21.8	18.90
Tanks/Ponds	0.004	102	.001	0.8
Open wells	3.522	1154	1.077	8.6
Bore wells	250.601	9607	76.65	71.50
Micro irrigation			0.22	
Other sources	0.006	39	0	0.3
Total Irrigated Area	326.18	13440		

Source: agricrop.nic.in/agriculture contingency/UP-2012& Statistical Dairy 2012, Govt of UP.

Table10: Distribution of cultivable and irrigated area block wise of MuzaffarnagarDistrict

Sl. No.	Block	No. of inhabited villages	Total Area	% of cultivable area to total area	% of irrigated area to total cultivable area
1	UN	102	38904.29	85.16	98.95
2	Kairana	51	21238.11	84.84	97.18
3	Thana Bhawan	58	23180.98	85.11	98.16
4	Shamli	43	18959.61	85.19	97.62
5	Kandhia	51	24313.18	86.79	98.33
6	Charthawal	66	26298.24	86.62	99.60
7	Purkazi	71	26477.54	80.70	98.40
8	Muzaffarnagar	49	21991.02	81.50	99.71
9	Baghara	49	21286.80	86.58	99.97
10	Budhana	54	23078.97	85.55	99.90
11	Shahpur	42	22292.78	86.51	100.00
12	Morna	59	32993.66	78.77	92.13
13	Jansath	89	40672.76	76.90	99.56
14	Khatauli	96	27994.75	86.60	100.00
	Total	880	369682.69	83.63	98.50

Source: District Census Hand Book-2011

Fig 11: Source of Irrigation:Muzaffarnagar District(2015-16)

Source of Irrigation

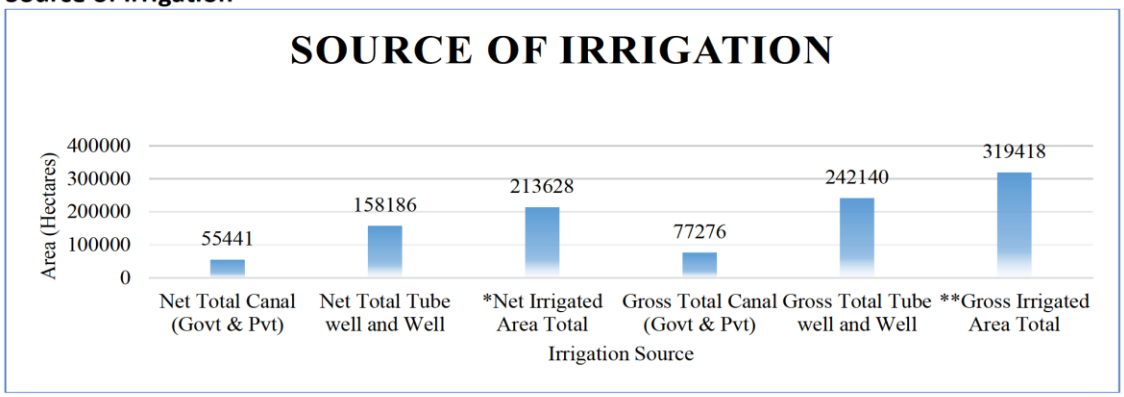


Figure 43 Irrigation Source: Muzaffarnagar

Table 64 Source of Irrigation: Muzaffarnagar

District	Net Total Canal (Govt & Pvt)	Net Total Tube well and Well	*Net Irrigated Area Total	Gross Total Canal (Govt & Pvt)	Gross Total Tube well and Well	**Gross Irrigated Area Total
MUZAFFARNAGAR	55441	158186	213628	77276	242140	319418

Source: aps.dac.gov.in/LUS (2015-16)
Unit: Hectares
**Net Irrigated Area: It is the area irrigated through any source once in a year.*
***Total/Gross Irrigated Area: It is the total area under crops, irrigated once and/or more than once in a year.*

Fig 12: Cropped Area Statistics:Muzaffarnagar District(2015-16)

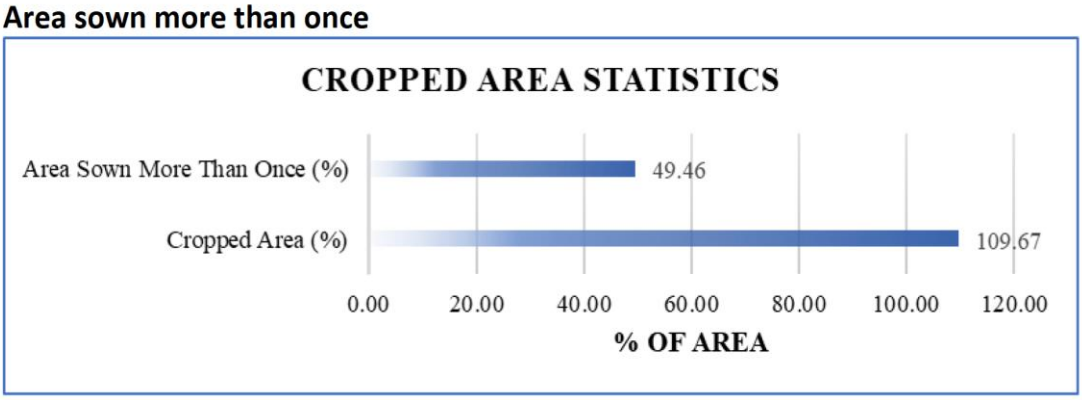


Figure 42 Cropped Area Statistics: Muzaffarnagar

Table 63 Cropped area v/s Area sown more than once: Muzaffarnagar

District	Cropped Area (%)	Area Sown More Than Once (%)
Muzaffarnagar	109.67	49.46

Source:aps.dac.gov.in/LUS 201516)

Kharif, Rabi and Zaid are three types of crops grown in the study area.The kharif is a rainy season crops like rice, sugarcane, arhar, bajra, groundnut, maize etc. Rabi is a winter crops like wheat, barly, gram, potato, pulses etc. Zaid is an intermediate crops of a few products like water melon, musk melon, pumpkin, cucumber, seasonal fruits and vegetable.

Table11: Sowing window for five major field crops (start and end of normal sowing period)

Sowing window for 5 major field crops(start and end of normal sowing period)	**Rice**	**Wheat**	**Sugarcane**	**Maize**	**Blackgram/Greengram**
Kharif-Rainfed	-	-	-	June	June-July
Kharif-Irrigated	June-July	-	-	June	March-April
Rabi-Rainfed	-	Nov-Dec	-	-	-
Rabi- Irrigated	-	Nov-Dec	April-June	-	-

Source: agricrop.nic.in/agriculture contingency/UP-2012

Major Crops-Area, Production and Productivity (Qtl/ha) Yields

The rice, wheat,bajra,barley and maize are important cereal crops in the state. Out of total GCA,25615 thousand hectares during 2010-11 in Uttar Pradesh, wheat accounted for highest share being 38.26 percent followed by 22.70 percent,3.67 percent,3.03 percent,0.78 percent and 0.64 percent of rice, bajra ,maize, jowar and barley respectively. Among the pulses gram, urd, arhar and moong are major pulses in Uttar Pradesh.Out of total GCA of 25615 thousand hectares during 2010-11 in Uttar Pradesh gram had occupied maximum share being 2.30 percent followed but 2.11

percent,1.30 percent and 0.32 percent of urd, arhar and moong respectively. Mustard, groundnut, til, sunflower, soyabean are important oilseed crops of the state.Of the GCA, mustard had occupied maximum share being 2.31 percent followed by 0.34 percent and 1.51 percent of groundnut and other oilseeds respectively during the same period.

The average production of wheat was 31.11 qtls per hectares in 2010-11 while the average production of barley, rice, bajra, maize and jowar was 24.93 qtls,21.22 qtls, 16.61qtls,15.04 qtls, and 10.30 qtls per hectare during 2010-11 in Uttar Pradesh.The average production of gram, arhar, moong and urd was 9.22 qtls,9.01 qtls, 6.78qtls and 6.35 qtls, per hectares during 2010-11.The average production of mustard was 11.85 qtlsfollowed by 9.93 qtlsof groundnut per hectare during 2010-11.

Table12: Major Crops-Area, Production and Yields (Year 2011-12) Tentative in Uttar Pradesh (Area in Lakh Ha. Production in Lakh M.T., YieldQtl/ha.)

Sl. No	Name of crops	Area	Production	Yield
	Kharif			
1.	Rice	59.23	139.63	23.58
2.	Maize	7.45	12.32	16.51
3.	Bajra	8.88	16.33	18.31
4.	Jowar	1.92	2.13	11.01
5.	Til	3.45	0.75	2.17
6.	Groundnut	0.92	0.92	10.01
7.	Sugarcane	21.62	1288.19	595.70
	Rabi			
1.	Wheat	97.31	318.92	32.77
2.	Barly	1.58	4.04	25.60
3.	Gram	5.77	6.84	11.85
4.	Mustard	6.39	7.28	11.36
5.	Potato	5.58	123.16	220.81

Source: Directorate of Agriculture,UP.

Note: The data of the area,production and productivity of different crops for 2011-12 in UP are tentative,so it has not been described.

Table13: Major Crops-Area, Production and ProductivityYields (Year 2013-14) Tentative in Muzaffarnagar District

S. N	Crops	Area (ha)	Production (qtl)	Productivity (qtl/ha)
1	Sugarcane	201436	151752584	586.00
2	Wheat	127085	452000	35.57
3	Paddy	22302	559111	25.07
4	Urd	1174	14400	4.38
5	Lentil	636	257	4.04
6	Gram	133	140	10.53
7	Pea	230	3300	14.35
8	Pigeon pea	108	214	19.810
9	Mustard	3937	5397	13.71
10	Sunflower	58	689	11.88

11	Potato	3620	74983	230.01
12	Cotton	274	356	1.30
13	Maize	200	2540	12.70
14	Arhar	118	770	6.53

Source: KVK, Muzaffarnagar, UP (2013-14).

Table14: Major Crops Grown Area in percentage

S.N	Crops	Area (ha)	%	Cumulative %
1.	Sugarcane	201436	54.69	54.69
2.	Wheat	127085	34.50	89.19
3.	Rice	22302	6.05	95.24
4.	Other crops	17559	2.84	100.0

Source: Krishi Vigyan Kendra, Muzaffarnagar, 2013-14

Fig13: Major Crops Grown in Muzaffarnagar District (2015-16)

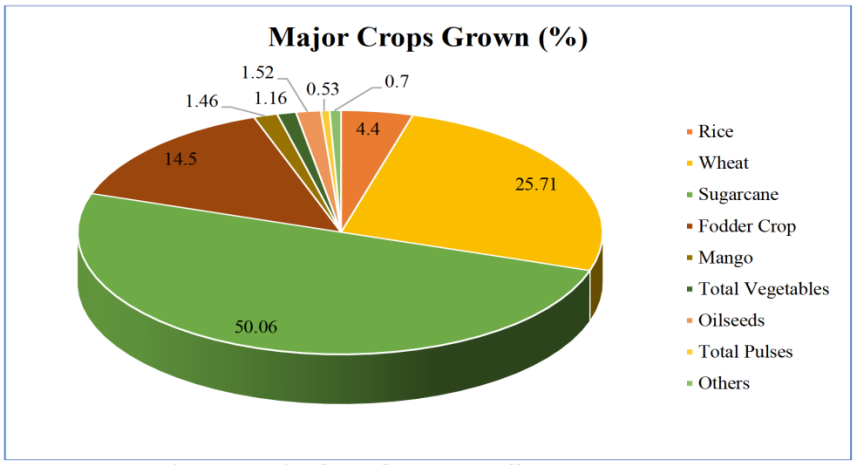


Figure 44 Major Crops Grown: Muzaffarnagar

Table 65 Major Crops Grown: Muzaffarnagar

District/Crop area percentage	Rice	Wheat	Sugarcane	Fodder Crop	Mango	Total Vegetables	Oilseeds	Total Pulses	Others
Muzaffarnagar	4.40	25.71	50.06	14.50	1.46	1.16	1.52	0.53	0.70

Source: aps.dac.gov.in/LUS (2015-16)

The sugarcane crops occupies 201436 hectares (54.69 percent of the gross cultivated area) of land (2013-14) but increased to 50.06 percent in 2015-16.The second largest area is under wheat crop covering 34.50 percent of net cultivated area (127085 hectares) but decreased to 25.71 percent in 2015-16. Rice occupies 6.05 per cent of the net cultivated area (22302 hectares) but 4.40 percentages in 2015-16. Other crops together occupy less than 5 percent of the total gross cultivated area(2013-14) but it was increased to 19.87 percentage including fodder crops, mangoes,total vegetables, oilseeds, total pulses and other in 2015-16. The land use analysis reveals that 95 per cent of the gross cultivated land is devoted to only three major crops in 2013-14 but its growing cultivated has been reduced to 80.13 percentage area in 2015-16.

Average productivity of major crops like wheat, paddy, oilseeds and mustard, potato in Muzaffarnagar district is higher as compare to the state average productivity, excepting sugarcane, maize, gram which are less than the state average productivity.Despite higher productivity of

cereals, oilseeds and sugarcane, majority of farmers in the district are facing acute problems due to small land holdings and irregular payment by sugarcane factory owners.

Status Cropping Pattern

The cropping pattern,a phenomenon of spatial nature refers to the yearly sequence,spatial arrangement and association of crops or fallow on a given area. Itplays a key role in agriculture productions; socio-economy and the environment.Cropping pattern variation can have significant environmental consequences, namely soil fertility, soil erosion and the global carbon balance. To accomplish the objective and to formulate the optimum cropping pattern within the agro-ecological region, an up-to-date knowledge and understanding of the existing cropping pattern is essential.

In case of Muzaffarnagar district ranking of crops, sorghum (Jowar) is followed by sugarcane, pigeon peas (toor dal), pearl millet (bajra). Weaver's method has identified ten crops combinations in the study region. Four crops combination appeared in Khatauli tehsil, six crops combinations in Budhana tehsil i.e., jowar, sugarcane, groundnut, maize, gram and bajara. Jansath tehsil comes under seven crop combinations. Six tehsils shows ten crops combinations as jowar, sugarcane, groundnut, sunflower, wheat, maize, gram, bajara, toor and fruits combinations

The rainfall, temperature humidity and other natural environmental factors along with socio-economic factors affect the cropping pattern in any region. The cropping pattern of the study area is dependent on the monsoon rainfall and water availability in the region. Rice, wheat and sugarcane are common where irrigation facilities are available.

The present study has noticed that there was a transformation of the cropping pattern in Uttar Pradesh from rice-wheat to rice-pulses/oilseeds and maize/jowar-wheat to maize/jowar-pulses/oilseeds depending on the pre-winter rainfall and water availability. The areas of pulses and oilseeds combinations were significantly increased because of higher return to the farmers. Single-cropping was observed in some areas.Singlecrops (i.e., maize-fallow, sugarcane-fallow) occupied a much smaller is within the study region.

Since the area is under crops for more than 200 days in a year, intensively cultivated with double and multi cropping practices are commonly seen in the study region. Similarly, among the various cropping patterns, rice-wheat, sugarcane-wheat and rice-pulses were the major cropping pattern of the total geographical area of the district Muzaffarnagar and Uttar Pradesh.

Major Farming System /Enterprises (based on analysis made by KVK)

The following major farming system has been derived for better classification, identification and management of agriculture land use in Muzaffarnagar district and Uttar Pradesh.

(i) Sugarcane based + Animal Husbandry (A.H) + Horticulture
(ii) Sugarcane based +Animal Husbandry (A.H) + Vegetable + Agriculture
(iii) Animal Husbandry (A.H) + Labour

Table15: Muzaffarnagar District: Description of Agro Climatic Zone & major Agro Ecological situations (AES)

S. N	AES	Characteristics of AES	Major Commodities	Farming System	Blocks
1	AES-1	More than 85% Area. Sandy Loam Soil	Sugarcane, Wheat, Rice, Jowar, Mango, Patato	Sugarcane based +A.H + Horticulture	Purkaji, Morna & Jansath

2	AES-2	More than 95% irrigated, Loam	Sugarcane, Wheat, Rice, Jowar, Mango, Guava, Litchi, French bean	Sugarcane based + A.H + Horticulture	Baghra & Sadar
3.	AES-3	More than 95% Sandy Loam	Sugarcane, Wheat, Jowar,	Sugarcane based +A.H+Vegetable+ Floriculture	Charthawal, Khatauli
4.	AES-4	Low Water table area, Loam & Sandy Loam soil	Sugarcane, Wheat, urd, Jowar, Mango	Sugarcane based + A.H + Horticulture	Budhana & Shahpur

Source: KVK, Muzaffarnagar, UP (2013-14).

Operation Thrust Area (2014-15) in Muzaffarnagar District

Operation Trust Area is the area or activities described as such in policy, as amended by its committee, from time to time (Table 16).Uttar Pradesh government has announced Operation Trust Area (2014-15) for all 75 districts of Uttar Pradesh including Muzaffarnagar District and certain measures are also recommended to protect its agriculture landuse and cropping pattern against all type of contingencies in the state. Details of Operational Trust Area (2015-16) in Muzaffarnagar district is shown at Table 16.

Table 16: Details of Operation Thrust Area (2014-15) in Muzaffarnagar District

Corps / Enterprise	Thrust Area
Sugarcane	IPNM, SSNM, Weed management, IPM, IDM, Seed production
Wheat	Integrated nutrient management, Weed management, IPM, IDM, Seed production, Foliar application of Micronutrients
Rice	IPNM, Weed management, Hybrid rice, IPM, IDM, Seed production
Vegetables	IPNM & IPM
Oilseeds & Pulses Crop	Sulphur, Zinc application & IPM

IPNM-Integrated Plant Nutrient Management
SSNM-Site Specific Nutrient Management
IPM-Integrated PestManagement
IDM-Integrated DiseaseManagement

Measure

Agriculture scientists actively seek to discover procedures that will increase livestock and crop yields, improving farmland productivity, reduce loss due to diseases and insects develop more efficient equipments, increase overall food quality and quantity to feed its people.

1. Maintenance of soil productivity through soil test based nutrient management.
2. Promoting intercropping modules with sugarcane.
3. Popularising bio-pesticides for management of insect pests.
4. Promoting quality floriculture as diversification enterprise for extra income generation.
5. Promoting quality vegetable nursery.
6. Mineral mixture supplementation among animals for improving fertility.

7. Promoting Group Approach of Extension (GAE) through Women SHGs and Vallabh Krishak Clubs.

In brief, agriculture land use planning are envisaged by the extension of agriculture land,raising the productivity of land,soil conservation,improved seeds yield pesticides, plant protection and better agriculture implements, change in the crop distributions and agro based industries in the study region.

Conclusion

A well though-out of strategy for promoting agricultural growth is essential for both alleviating poverty and achieving food security in national level.Agriculture now is not merely protection oriented but it becoming an agribusiness consisting of enterprises such as livestock,poultry,fishery, silviculture,sericulture,agriculture,and lac culture along with field and forage farming, and plantation crops.These are the stepping stones of green, white, yellow, golden and blue revolutions, having the tremendous potential for life and longevity in this greenearth.Finally,the development of agriculture landuse and cropping pattern has much to do with cultural and socio- economic welfare of our country.

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