Analysis of landuse landcover with spatio-temporal relation to the soil characteristics at Amdabad Mouza, Chinsurah, Hooghly

Ayan Kumar Maity[1] and Souvik Das[2]

[1] Ayan Kumar Maity, HOD, Narua Sikshanikatan, Chandannagar, West Bengal, India

[2] Souvik Das, Research Scholar, The University of Burdwan, Burdwan, West Bengal, India

Abstract

Soil beings the seat of all biotic properties supports plants life and hence the agricultural activities. So, the study of soil is a prime necessary from the point of view of agriculture. The composition and fertility of soil vis-à-vis crop production varies from place to place. Amdabad Mouza, where priority of arable agriculture is gradually decreasing than orchard farming due to various physicals and non-physical factors. Soil is the basic determinant of landuse of any region. It is the natural body on which the plant grows. It is also a most important natural resource widely used by man for various purposes. For the purpose of agriculture, the study of soil character in terms of structures, texture, nutrients status etc. becomes essential. There is no dearth of willingness in the part of the people to engage in orchards farming than the traditional agriculture. Therefore, it is an ideal case study area for seeing changing landuse pattern. Landuse is any kind of permanent or cyclic human intervention to satisfy human needs. Landuse is the application of human controls upon land in a systematic manner. In this paper an attempt has been made to study the soil character and the impact of urbanization on agricultural landuse of Amdabad Mouza (Polba P.S., Hooghly District, West Bengal, and J.L NO. 193).

Keywords: Soil, Plant, Agriculture, Structures, Texture, Nutrients, Landuse and Landcover

1.0 Introduction

A central component in current strategies for managing natural resources is the Landuse/Landcover change which monitoring environmental changes. The concept of vegetation mapping has greatly increased with advanced in research on landuse/Landcover change which can provide an accurate evaluation of the spread and health of the world's forest, agricultural and grassland resources which has become an important priority. To the understanding of the influence of man's activities, viewing the earth from space is now crucial on his natural resource base over time. One of the most important environmental issues in present time is Land use/land cover change and it considered as a global concern (Guan et al., 2011, Veldkamp and Lambin, 2001). The associated habitat loss and changes in land use/land cover and fragmentation are major causes of biodiversity loss (Sala et al., 2000). By so many human activities as. like as deforestation, urbanization, agriculture intensification, overgrazing, and subsequent land degradation such changes are usually caused, however natural factors can also contribute to these changes (Lambin, 1997). Changes such as overgrazing and shifting to intensive agriculture are major causes of land degradation in arid lands. The declination in natural resources is the cause of these kinds of human-induced changes and can affect food supply in these areas resulting in serious socio-political consequences (Turner II et al., 2007). For detecting changes on the Earth's surface at different scales the availability of remotely sensed data is growing advances in their temporal, spatial, and spectral resolutions continue to provide tools (Rogan & Chen, 2004; Wu et al., 2006). It provides information about the understanding of the dynamics of these changes for managing natural resources and better decision making for using (Lu et al., 2003). As ‘the process of determining and/or describing changes in land use/land cover prope rties Rogan and Chen (2004) defined the digital change detection based on co-registered multi-temporal remote sensing data.For assessing change various techniques are used including both rule-based methods and statistical analysis. In so many literatures such as Singh (1989), Lu et al. (2003), Coppin et al. (2004), and Rogan and Chen (2004), reviews of these techniques and their applications can be found completely.To detect where the change occurred or will potentially occur, land use/cover change models usually seek (Veldkamp & Lambin, 2001). The knowing factors contributing to the change, the models where the change may occur provide probabilistic prediction (Overmars, de Koning, & Veldkamp, 2003). The change drivers often include type of the soil, distance to roads or other facilities, increase in population and also preceding land use. To assess the cumulative impact of land use change Land use/ cover models are used and develop for predicting future scenarios (Veldkamp & Lambin, 2001), which help and support for decision making as well as for land use planning (Guan et al., 2011). In these models, with historical land use data where the past land transformation and transition is assessed change analysis is conducted. To provide an estimate of the future scenarios, the transition trend detectation is incorporated with environmental variables (Eastman, 2009; Pijanowski et al., 2002). As they attempt to manage and mitigate impacts, such projections are useful to resource managers, land use planners and conservation practitioners (Pijanowski et al.,2002). In different applications, Prediction of LULC change have been used, such as through the modeling urban planning and rural development and urban growth (e.g., Theobald & Hobbs 1998); setting alternative conservation measures and selecting conservation priority areas (e.g. Menon et al., 2001); studying shifting cultivation dynamicity(e.g. Wickramasuriya et al., 2009); and under different climate change scenarios simulating rangeland dynamics (e.g. Freier et al., 2011). In many landscapes, land-use change, particularly the conversion of forests to pasture or cultivated fields and vice versa is a common occurrence and one of the dominant factors which functioning of terrestrial ecosystems, affecting the biodiversity (Sala et al., 2000). On the physical and chemical properties of soils, the effects of alteration in land-use have been well studied. The land-use change can have significant role on mechanism of soil texture, pH and long-lasting effects on soil carbon and nutrient contents (Post and Mann, 1990; Murty et al., 2002), associated management practices across land-use types and effects that largely arise from changes in plant species composition. The changes in landuse also have a significant effect on microbial communities and a numerous studies have shown (Bossio et al., 1998; Johnson et al., 2003; Ovreas and Torsvik, 1998; Steenwerth et al., 2002; Zelles et al.,1992), and how land-use (and the associated changes in plant and soil properties) may affect the abundance of specific taxonomic groups we have a poor understanding. For instance, in identifying edaphic properties which influence microbial community structure, culture-independent techniques such as PLFA and FAME have proven useful (Bååth and Anderson, 2003; Bååth et al., 1995; Frostegård et al., 1993) and the scenario of shifting from forest to agriculture may influence litter decomposers (Carlile et al., 2001).The biogeography of each group would be controlled by separate edaphic factors and the fundamental differences in bacterial and fungal physiology and ecology would suggest that which may vary among land-uses (van der Wal et al., 2006). For example, to shifts in vegetation type than soil bacteria fungi may be more sensitive, associations with specific plant types particularly mycorrhizal fungi form symbiotic (Heinemeyer et al., 2004) or Basidiomycota which are involved in decomposing lignified plant detritus (Bardgett and McAlister, 1999). Likewise, the same types of carbon substrates in soil, bacteria and fungi may not mineralize, and therefore, on these two groups of microorganisms shifts in carbon pools may have different effects (Bossuyt et al., 2001; Six et al., 2006). This paper mainly focuses on the changes in landuse landcover from previous to present with the change of time, besides describing the type of soil and the pattern of soil texture and allover characteristics of soil and plant distribution of the selected study area, as well as the nutrient status of the soil and its suitability for the plant growth. This research has been done on the subject overall.

2.0 Study area

Amdabad Mouza of Polba P.S. of Hooghly district, West Bengal is located on the right bank of River Saraswati. It's with the J.L. no.193. The Mouza covers total of 1.06 sq.km areas. It is situated about 2 km to North from Chandannagar Railway Station. It is about 8 mt. from mean sea level. The latitude and Longitudinal extension of the study area is 22°52'45"N to 22°53'15"N, 88°20'30"E to 88°21'30"E.

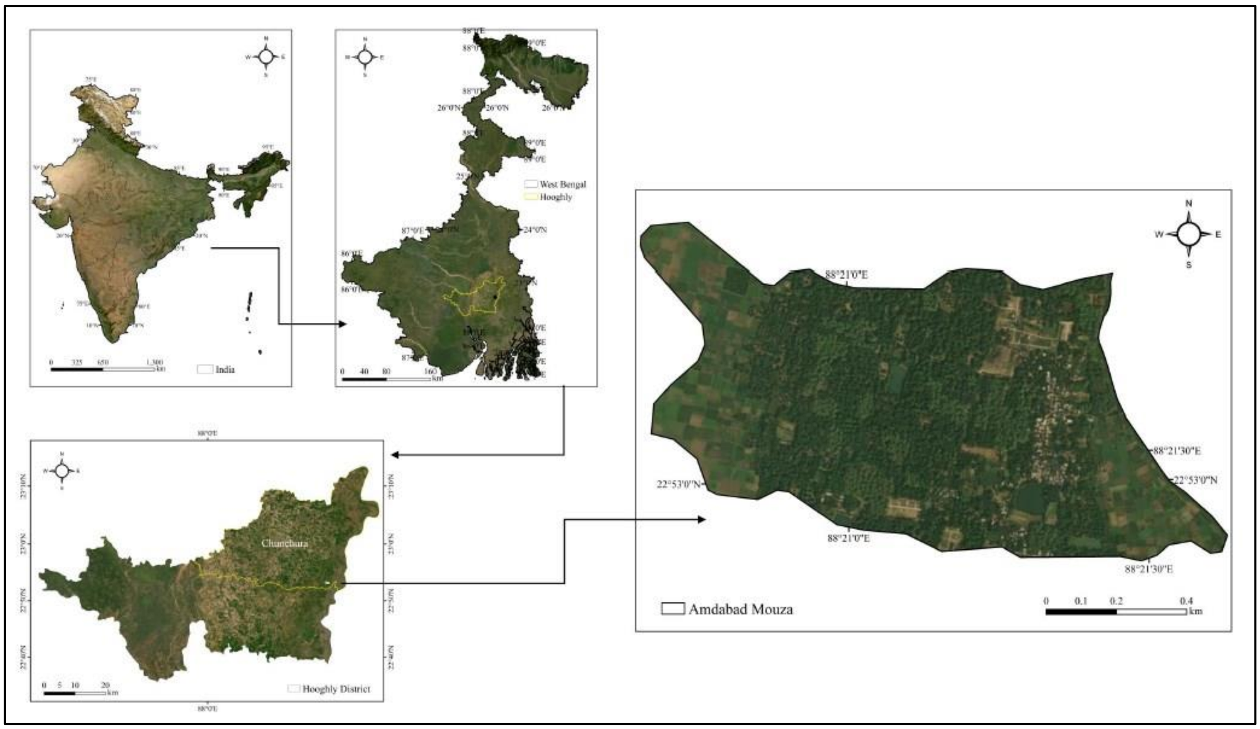

Fig. 1.1. Amdabad Mouza (Extracted from Google Earth Pro)

3.0 Objectives

The following objective of the study area Amdabad Mouza, Hooghly district are following:

1. To identify how landuse and landcover patterns have changed from the previous period to the current period.

2. Identification of soil characteristics to understand the basic soil pattern and properties of the area.

3. Identification of nutrient status for the plant with a view to mitigating the general deficiencies of the nutritional properties of soil.

4.0 Methodology

In course of preparing this paper several methods have been adopted. These are mentioned below:

1. Collection and interpretation of available literatures, data, maps of the study area.

2. The entire area has been divided into 18 sample grids for soil samples have been collected from the cross section of each grid.

3. Soil samples are then carefully analyzed in the laboratory for estimation of organic carbon, N.P.K and pH with the help of soil kit or by other Laboratories laboratory techniques.

4. Fertility rating map of has been prepared by Aziz method.

5. General land use particular only agriculture in terms of soil characteristics has been analyzed.

6. Statistical Techniques has been adopting to establish the vital causes behind such changing land use pattern.

7. Several cartographic tools have been applied for mapping and diagrammatic representation of the computed data.

8. Google Earth Pro

9. Google Earth Pro software was used to consider the selected study area and the selected area was identified.

10. Pilot and questionnaire Survey followed to gain a specific understanding of the entire area.

5.0 Discussion

5.1 Physical environment

With a small geographical area around 22.03 km^2 (Draft Development Plan-CMC, 2012-2017 the CMC occupies, and on the newer alluvium deposition of greater depth of Gangetic delta is situated and this being a part of the Great Bengal Basin. An abandoned channel of the

Bhagirathi, the River Saraswati, flows through north and north-west margin of the city, The Bhadeswar Khal flows through the west. Through the eastern part the G.T. Road runs and through the middle of the city the Eastern Railway runs and through the western border of the city the Delhi Road runs. During the early Holocene age, the deposition of the material has taken place. In Holocene age with clay, silt, sand and gravels deposited, the subsurface deposits are purely unconsolidated material. Generally, the slope is from north towards south direction. The average elevation of the CMC ranges from northern part of from 8.0 m to 9.0 m in the southern part which is further reduced, from 7.0 m to 7.5 m (Draft Development Plan-CMC, 2007-2012). With thick clay layer, the surface of the city is covered which has provided opportunity to form a number of various sizes ponds. Under tropical sub-humid monsoon climate regime, the study area lies. After Thornthwaite it is classified as 'Moist Sub-Humid type' of climate. Annual rainfall of the area is around 1453.7 mm. During the monsoon season from June to September, maximum of rainfall occurs. In this area the average mean monthly temperature is around 25.7℃ and in the month of May (30.7°C) and January (17.9°C) maximum and minimum temperatures of the area are observed respectively.

5.1.1 Geology

The entire geological structure of the area is marked by older alluvial deposits of the River Hooghly and River Saraswati. According to the investigation of the director general of the Geological Survey of India (GSI), this area consists of the following succession of deposits such as Top soil, Clay and silt, Clay, Fine to medium gradient sand, Coarse grained sand occasionally mixed with gravel.

5.1.2 Relief, Drainage and Morphology

Generally, these are part of the flat plains of the lower Gangetic Delta. From previous field report about Amdabad conducted by Geography Department of Chandannagar Govt. College (Dec.1992) and a present investigation. The total mouza was divided into three parts such as central uplands, the eastern lowlands and the western lowland. The central part of the mouza is elevated above 10-11m. while the eastern part besides river Saraswati and the western part are low land at about 8m. There are a few minor undulations over this broad pattern.

River Saraswati is only drainage system on this mouja. This is a tributary and also a distributary of river Hooghly near Triveni and joins the Hooghly downstream near Andul, sankhrile, Howrah. Such a drainage pattern is quite common in the Ganga delta it is called an Anastomosing pattern.

The morphological survey reveals that the eastern and western lowland are Alluvial flood plain and the central upland is in fact raised earth by man. A Peculiar future is that the Eastern Roland also situated beside the reward each narrow in extent than the western lowland it appears that the central was originally a continuity of the flood plains. That is to say the entire area of the mouza was originally of flood plain, the central part of which had been raised to and a plant by man to suit his purpose. The discontinuous high bank of river Saraswati or remnants of an alluvial level. The present discontinuity of the level is due to subsequent weathering and erosion. A conspicuous feature of this mouza is an ox-bow-lake of River Saraswati. Another feature of the Eastern lowland is the presence of several man-made channel issuing from the river and ending a little distance within the agricultural field. The channel is dug undoubtedly to facilitate irrigation.

5.1.3 Climate

The climate is hot in all seasons, but moderately comfortable. The temp. of hot weather is between 26°C to 28°C and the cold weather is around 18°C, there is high humidity round the year, especially from March to end of October. In the beginning of March temperature raised rapidly and which is maximum during the month of April and May. Mean maximum temperature is 36°C and the minimum is 24°C. The maximum temperature is sometimes 46°C to 47°C.

5.1.4 Vegetation

The vegetation has been shaped as much by human agencies by climate and soil. Agriculture (Arable), Orchard, Settlement, Road etc. has caused the important change in the structure and composition of plant communities in Polba P.S. as well as at Amdabad Mouza. The main species are now the mango, jack fruit, tentul, payara, sial kanta, dubbo grass along with some wild bushes.

5.1.5 Soil

Generally, soils of this mouza are alluvial in nature. These are an azonal soil class. From textural analysis it may be said that the central upland consists of loamy soils while the western and eastern lowland consists of clay loam. There is only one exception Sandy Loam Soil has been encountered in the alluvial levees beside river Saraswati.

5.1.6 Land and Soil

Land and Soil both are dependent on each other. Landuse pattern of an area broadly reflects the type and character of a soil. Among all physical limitations in agricultural activities, soil is the base which plays a significant role in land utilization.

5.1.7 Water level

More than 70% of the total population of W.B. depends on agriculture. In term of area it is followed by arable land, bamboo groves, water bodies, residential land and finally waste land. The dominance of orchard is crucious. It appears that orchard provides better profit at lower cost than arable agriculture. The most interesting fact is that the orchard area has been increased in present than previous years. The settlement area has also been increased. But the arable agriculture area drops down from previous amounts of percentage.

5.2 Properties of Soil

Soil can be improved in and made productive by changing its properties. Soil of different origin possesses different properties. A surface soil sample and a short profile description have discussed shortly and besides different types of properties of soil are specifically discussed and besides different physical properties and different chemical properties of soil are broadly described as follows.

5.2.1 Study of surface soil sample

The fertility of soils of a nutrient is largely depends on physical chemical and biological characteristics of soil. Difference among these properties determines the qualitative status of various soils. Inherent characteristic of soil influenced by the soil forming processes, determine the composition and structure of the soil. For instance, the composition of the soil is changed through the application of various inputs, or through cultivation and ameliorative measures, which is also responsible for change in the nature of properties. In order to control these properties these should be known properly. As soil develops, it undergoes change and passes from the qualitative state to another with increased fertility. But not all change in soil lead to an increase of its productivity some change such as leaching, Stalinization and swamping or excessive accumulation or destruction of volcanic matter etc. lead to a worsening of the physical and chemical properties of soil and lowering of the fertility.

5.2.2 Profile description

Soil profile is a vertical section through a soil which consists of various horizons which differ from one another in colour, texture, structure, pH consistency. The individual layers are regarded as horizons. In judging a soil, its whole profile should be taken into consideration. The upper layers of a soil profile generally contain considerable amounts of organic matter and are use usually darkened because of search and accumulation and are referred to as the major zones of organic matter accumulation. The underlying sub soil being markedly weathered content comparatively less organic matter. The texture depth, coloure, nature and adequacy of the various horizons characterize a soil and determine its agricultural value.

5.2.3 Properties of soil

Soil properties help to determine the character of land as well as the use in which it would be engaged. Physical and chemical these two types of properties are discussed here; Physical properties have been estimated mostly by field observation whereas chemical properties have been determined by laboratory tests.

5.2.3.1. Physical properties of soil

Soil physical properties are those which can be evaluated by visual inspection or by feel method. Physical properties of soil greatly influence its use and behavior towards plant growth. Besides penetration of roots, drainage aeration of moisture and plant nutrients are primarily linked with the physical conditions of the soil. Physical properties also influence the chemical and biological behaviour of a soil. Texture, structure, depth, property, consistency, colour, moisture, temperature density and shrinkage and expansion are all important physical properties in soil. But here only soil texture and soil colour have been studied in detail. For the agricultural production the physical properties of the soil are very important. The amount and rate of oxygen, water and nutrient absorption by plants, depend on the ability of the roots.

5.2.3.1.1. Soil texture

Soil texture refers to the relative proportion of the three mineral fractions namely sand, silt and clay. The texture was determined by feel method of soil. A clod of soil was pressed and rubbed between thumb and forefinger as is feel was noted as indicating of texture. A gritty feel indicates sandy texture; a powdery soapy feel indicates clayey texture. In additional a role of the moist soil was made and the deformation of cracks upon its bending was noted as another indication of texture. 18 soil samples were examined by this method. The distribution of the textural type has a neutral forms and clear patterns.

5.2.3.1.2 Soil colour

Colour is the most useful and important characteristic for the soil identification. Although it has a little direct influence on the functioning of soil but it helps to inform that adequately about a soil colour is related to organic matter content, climate, and soil drainage and soil mineralogy. Soil colour me also be inherited from its parent material. Soil colours are conveniently determined by comparison with ‘Marsell colour chart’. It consists of some 175 coloured chips systematically the arranged. The arrangement of three variables of high value and Chroma combines to give all 175 colours. The same method has been adopted to determine the soil colour of the of the study area.

5.2.3.1.3 Soil Structure

Sand, silt and clay are found in aggregated from in the soil body. Arrangement of three particles in certain definite pattern is called soil structure. The natural aggregates of soil particles are called ‘ped’ whereas, an artificially formed soil mass is called ‘clod’. Soil structure determines the retentively of moisture and nutrients. Two types of soil structure are recognized here, i.e. Block likes and spherical. Excessive drainage facilities, aeration and root penetration are the main advantage of soil structure.

5.2.3.2. Chemical Properties of Soil

This property is of the highest significance both in the control of the pathogenic processes and in the life of plants. Chemical elements of the soil are formed by the chemical weathering of rocks. It denotes changes in chemical properties of rock forming minerals. The following aspects are included as chemical properties of soils such as organic matters in soil, inorganic matters of soil, soil reactions and colloidal properties of soil particles, buffering action in acidic soils and basic soils. In the soil there are almost 90 different chemical elements among them over 50 types of soil organisms, and a variety of combinations of soil texture and tilth. In the periodic table, around 95 of the 118 elements are metals (or are likely to be such). Due to a lack of universally accepted definitions of the categories involved the number is inexact as the boundaries between nonmetals, metals and metalloids fluctuate slightly. Some important chemical properties (pH, Phosphate, Potash, Nitrogen, Organic Carbon etc.) of the soils of Amdabad Mouza are discussed below:

5.2.3.2.1 Soil reaction or pH

Acidity is caused by the presence of positively charged hydrogen ion in the soil solution. It is defined as the negative logarithm of the concentration of hydrogen ions in a solution, measured in moles per liter (a mole is the molar weight of a substantial in grams).

$$Ph = -Log\,[H+]$$

A soil said to be acid if the pH is less than 7, natural if it is 7 and alkaline if the pH is above 7. There are major causes for acidity of the soil i.e. (1) accumulation of raw organic matter, (2) application of fertilizer used in much quantity and (3) degree of intensity of leaching.

5.2.3.2.2 Nitrogen

It is an integral part of plant protein which is a vital part of protoplasm. It tends primarily to encourage above ground vegetable growth. For growing of plant (structure) Nitrogen is really important, food processing of plant (metabolism), and for the creation of chlorophyll. The plant cannot grow taller without enough nitrogen in the plant or produce enough food.

5.2.3.2.3 Potassium (K_2O)

It is a vitally important mineral element which the plant requires in the largest quantity. It is the third essential elements, most often next to nitrogen and phosphorus. Expressed as the oxide (K2O), the ordinary range of potassium, in the upper or low surface of mineral soils range from 0.15 percent in sands to 4 percent and over in clay soils. the general run of soils contains fairly large quantities of potash with an averaging approximately 2%.

5.2.3.2.4 Phosphorus(P_2O_5)

Phosphorous is also a most important nutrient of plant. The role of these elements in plant life is similar to that of nitrogen. Generally, in the most surface soils layer the total phosphorus content is low with an averaging only 0.6%. An average soil content of 0.14% nitrogen and 0.83% potassium as to compare.

5.2.3.2.5 Organic Carbon

The surface layer of soil is constantly receiving addition of organic matter either leaves or other debris of vegetation covering the ground together with the dropping of animals consuming that vegetation, or dung and other animals and vegetables residues supplied as managers to the cultivated land. These materials rapidly change in ordinary soil. It is vitally important for soil fertility climate conditions; especially temperatures and rainfall exert a dominant influence on the amounts of organic carbons. The organic carbon of the soil of this Mouza is under medium group. There is no remarkable variation in such homogenous pattern.

5.2.4 Determination of nutrient status in term of N.P.K

The concept of soil fertility is very complex. There is no absolutely scale of fertility because of the consideration the use to which land or soil is put. Soil fertility is the quality that enables the soil to provide proper compounds in proper amounts and in the proper balance for the growth of specified plants, where others factors, such as light, temperature, moisture and physical condition is widely recognized. In this section fertility rating of Amdabad Mouza has been determined by the help of Aziz's Method.

5.3 General landuse pattern

Landuse is any kind of permanent or cyclic human intervention to satisfy human needs. For different purposes land is used such as agriculture, mining, forestry, building houses, roads and setting up of industries. Landuse is the application of human controls upon land in a systematic manner.

5.3.1 Agricultural activities

The agriculture landuse pattern has been shown in three cropping season – Rainy, winter and summer. The entire agricultural land is located in the low lands. Not only the topography but also the clay loam soil texture also favours arable agriculture in this area.

5.3.1.1 Condition in Rainy season

The arrival of the rainy season results in a large amount of rainfall which results in the cultivation of a variety of crops i.e. in short water scarcity does not occur mainly during this rainy season which is particularly suitable for the cultivation of the area. About 92% of the arable agricultural area is under cultivation in the rainy season. The remaining 8% is left fallow in the current season.

5.3.1.2 Condition in Winter Season

The winter season is the season of greatest agricultural activity in this Mouza because of availability of irrigation water on the surface and in the sub-surface, comfortable condition for human activity, adequate temperature for a great variety of crops and the water retentive clay loam soil.

5.3.1.3 Condition in Summer season

As expected, that, extend of agriculture diminishes in the summer season on account of difficulty of supplying irrigation water. Only 38% of the total arable land is cultivated in the summer seasons. The choice of crops also becomes sharply limited. There are only two crops (i.e. rice and jute) and some vegetables.

5.3.2 Irrigation activity

Among the total agriculture area about 85% of land is irrigated. Irrigation becomes a necessity for cultivation in the two dry seasons. There are two main source of irrigation water are surface water and ground water.

5.3.2.1 Supply of water in irrigation activity

The source of surface water is the River Saraswati and many short close-ended man-made channels issuing from it. The surface water is lifted to the fields by diesel pump. The surface water is available only in the Eastern lowlands and there again only the winter. The surface water dries up or becomes too shallow for irrigation in the summer when ground water is the source of irrigation. In the western lowland's groundwater is the source of irrigation in the winter an d also in the summer. The ground water is tapped by means of shallow tube well fitted with diesel pump. Interestingly there are no ponds in the lowlands; and ponds are no source of irrigations.

5.3.3 Multiple cropping

Agriculture is practiced with great intensity in the Mouza. About 55% of the total arable lands are double cropped and 20% tripple cropped. Such intensive agriculture is made possible by the arrangement of irrigations facilities during the dry seasons. Among the two dry seasons the winter is favored by the availability of surface water and course ground water. Hence, this season see more extensive cultivation.

5.3.3.1 Orchard cultivation

Orchard is the most important landuse type so far as area is concerned. It covers about 52% of the total area of the mouza. Interestingly, the orchard occupies the central uplands. The orchard is characterized by a great variety of perennial fruit trees and inner-cultivation of seasonal crops. No less than eight different fruit trees are cultivated here.

6.0 Result

6.1 Properties of soil

Various kinds of soil properties and its present condition in the study area have been analyzed in the discussion section and in this result section that kinds of properties have been discussed broadly and the distributional condition in different part of the Amdabad mouza clearly analyzed so that the dominant and suitable factors of different parameters can be understand. Into three primary types soil can be classified based on its texture – sand, silt and clay. However, the percentage of these can vary, resulting in more compound types of soil such as loamy sand, sandy clay, silty clay, etc. The Physical Properties of Soil such as Soil Colour, structure, texture density, porosity, temperature, and air are all. From place to place soil colours are vary greatly and indicate properties such as redox conditions, organic matter, water and so on.

6.1.1 Soil texture

The central upland consists of loamy soil while the Western and Eastern lowland consists of clay loam. There is only one exception, sandy loam soil has been encountered in the alluvial levels besides the River Saraswati. The central upland was developed by man for growing fruit trees. It appears that while raising the ground Man Purposefully added loamy soil from elsewhere to is to suit the fruit trees. The sandy loam soils over the alluvial levees and the clay loam soils in the flood plains away from the rivers are expected feature. These patterns have resulted from the deposition of course material nearer the stream and finer material away from the stream. In terms of the areal distribution, the loamy soil over the central upland occupied the greatest area of followed clay pipe in the eastern and western lowland these shows the importance given to the fruit Trees by the farmers of this Mouza.

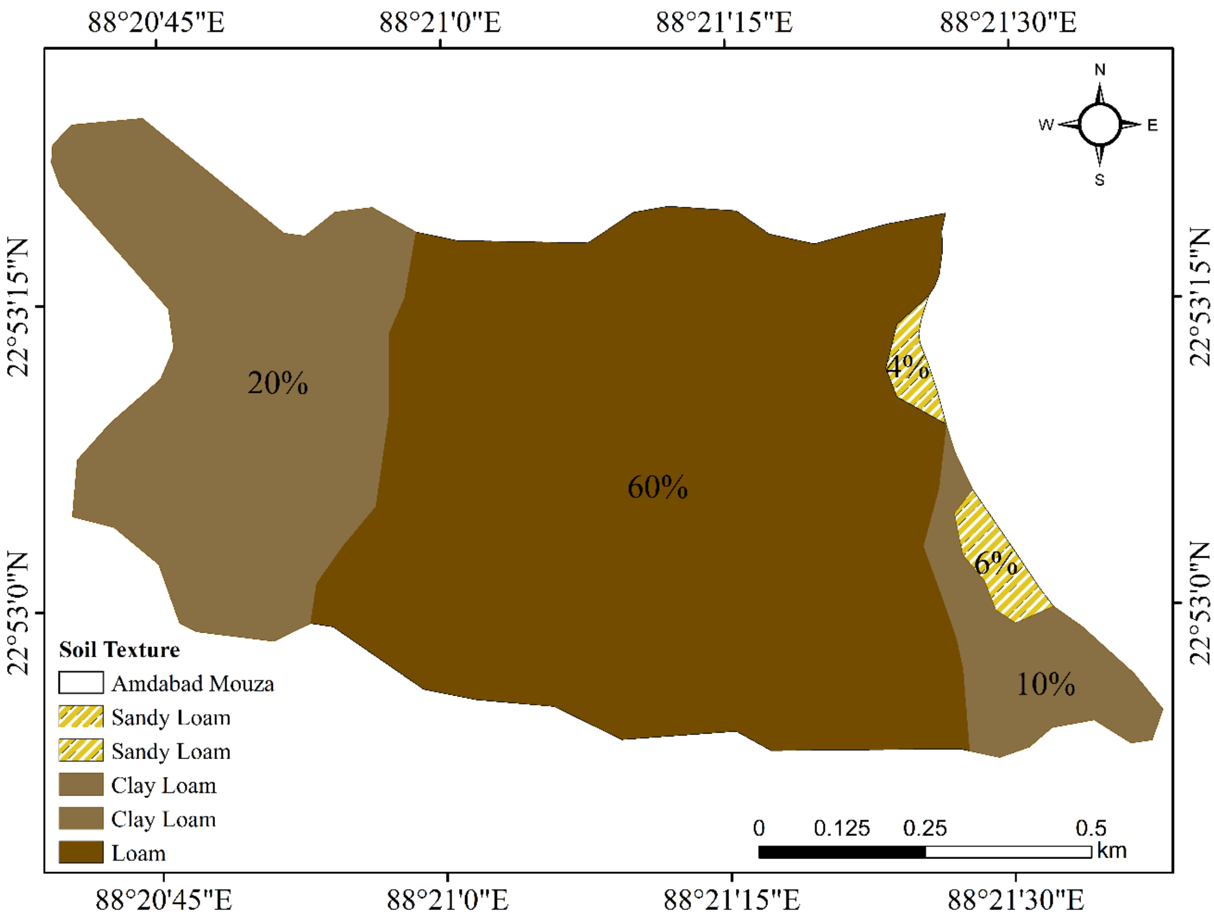

Fig.6.1. Soil texture

6.1.2 Soil colour

Generally yellowish-brown soil colour has been occurred in Eastern lowland. Grace Brown Colour has been occurred mainly along the settlement area of the Mouza. Beside the remaining major part of the Mouza is under olive brown to light olive brown. For correctly identifying soil, soil color can be a useful tool and for the soil health it can be an important indicator. Soil color is linked to mineral composition, soil organic matter, soil fertility, and more. For example due to the abundance of iron oxide under oxidised conditions (well-drainage), the red colour in the soil can generate in the soil; due to the accumulation of highly decayed organic matter the dark colour is generally generate; yellow colour is due to hydrated iron oxides and hydroxide; due to manganese oxides black nodules are generate. To identify problems of waterlogging or leaching a very careful observation of colour can help. Poorly drained soils are often dominated by blue-grey colours and a well-drained soil will usually have uniform colours and bright also.

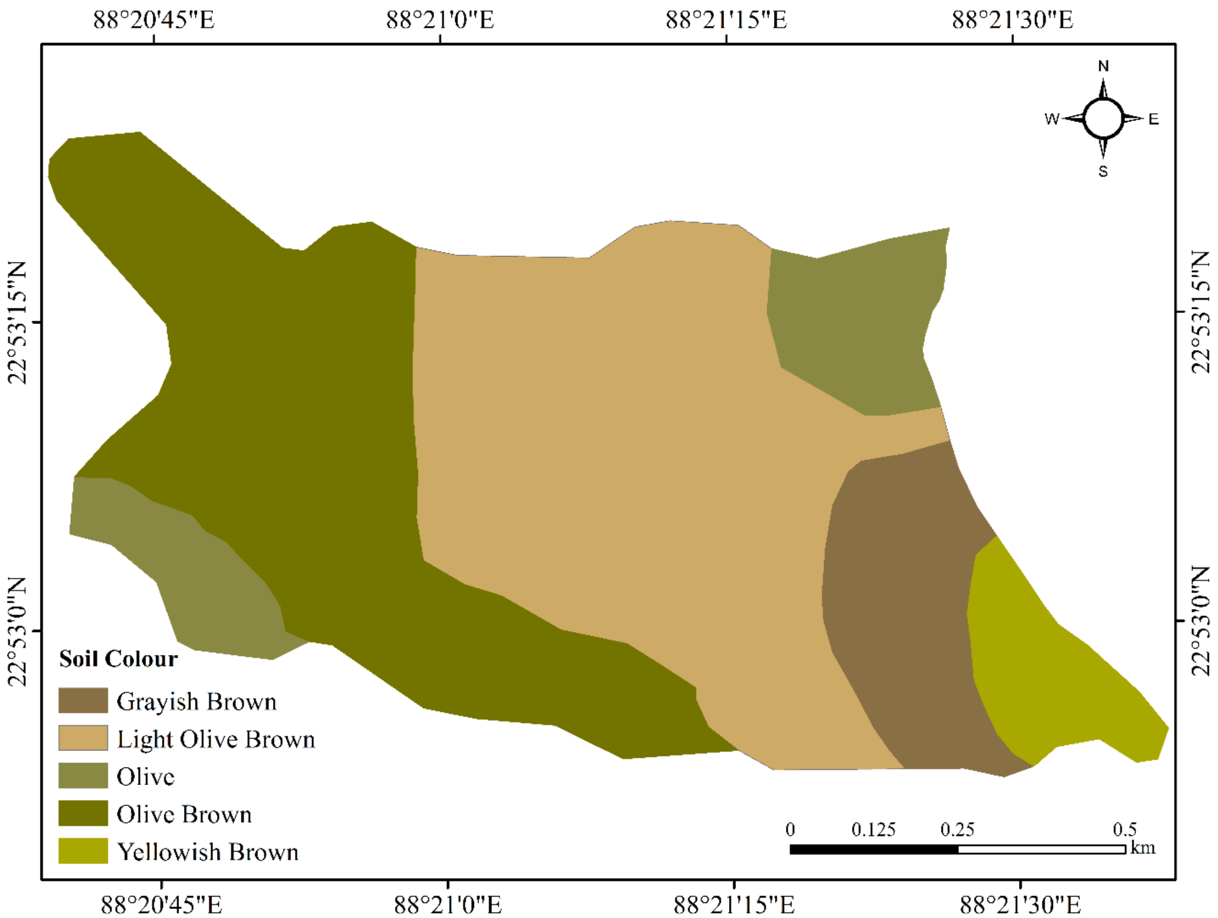

Fig.6.2. Soil colour

6.1.3 Soil pH

Soil acidity is a common phenomenon throughout the Mouza except few parts of western lowland. The pH varies from 4.5 to 7.0. The acidity has been increased (strong) in central upland of the Mouza and also in Low land areas (26%). Typically, dark brown or black colors indicates that the soil has a high organic matter content. Organic matter coats mineral soil particles, which masks or darkens the natural mineral colors. It may be said that 39% area of the Mouza where pH is under most satisfactory condition, for plant growth.

Global variation in soil pH

Red = acidic soil.

Yellow = neutral soil.

Blue = alkaline soil.

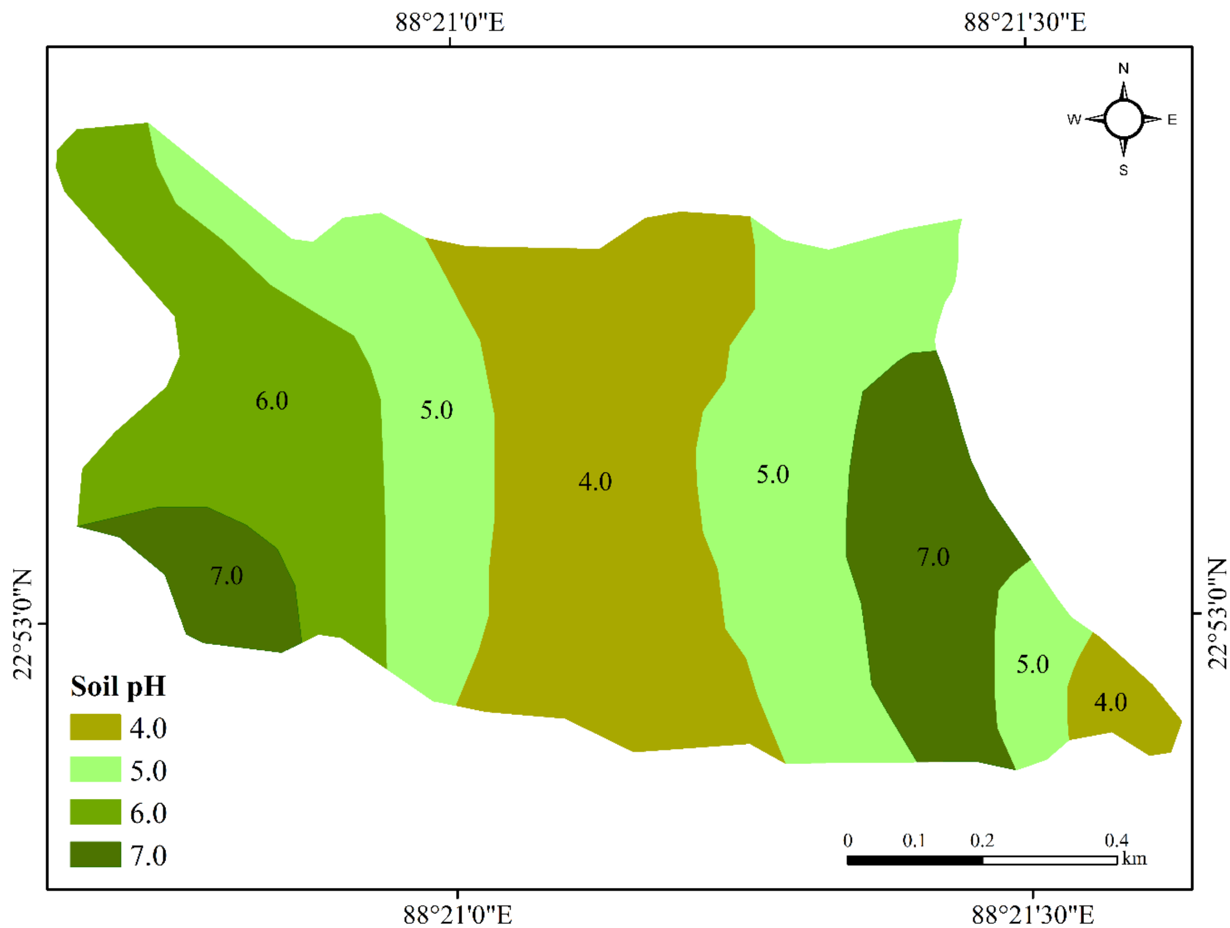

Fig.6.3. Soil pH

6.1.4 Nitrate Nitrogen status

In the soil Nitrate-nitrogen (NO3-N) measures the amount of available nitrogen by plants that can be absorbed immediately.

With extreme nitrate levels although many aquarists run their tanks, the ideal is a maximum of 5 to 10 ppm and the levels of 20 to 50 ppm are too high. Freshwater tanks can be at the higher end, at the lower end marine fish-only setups and reef tanks as near zero as possible.

The amount required for specific crops varies from crop to crop in the soil, but in generally should not fall the levels below 10 mg/kg and it also should not exceed 50 mg/kg. Nitrate Nitrogen status of this Mouza soil is under high grand except 9% area (medium), whereas ammoniacal nitrogen is under medium group, except 13% area (high). Generally, the Nitrogen status of the soil of Mouza has very much satisfactory group. These are due to use of very many fertilizers and also other local factors.

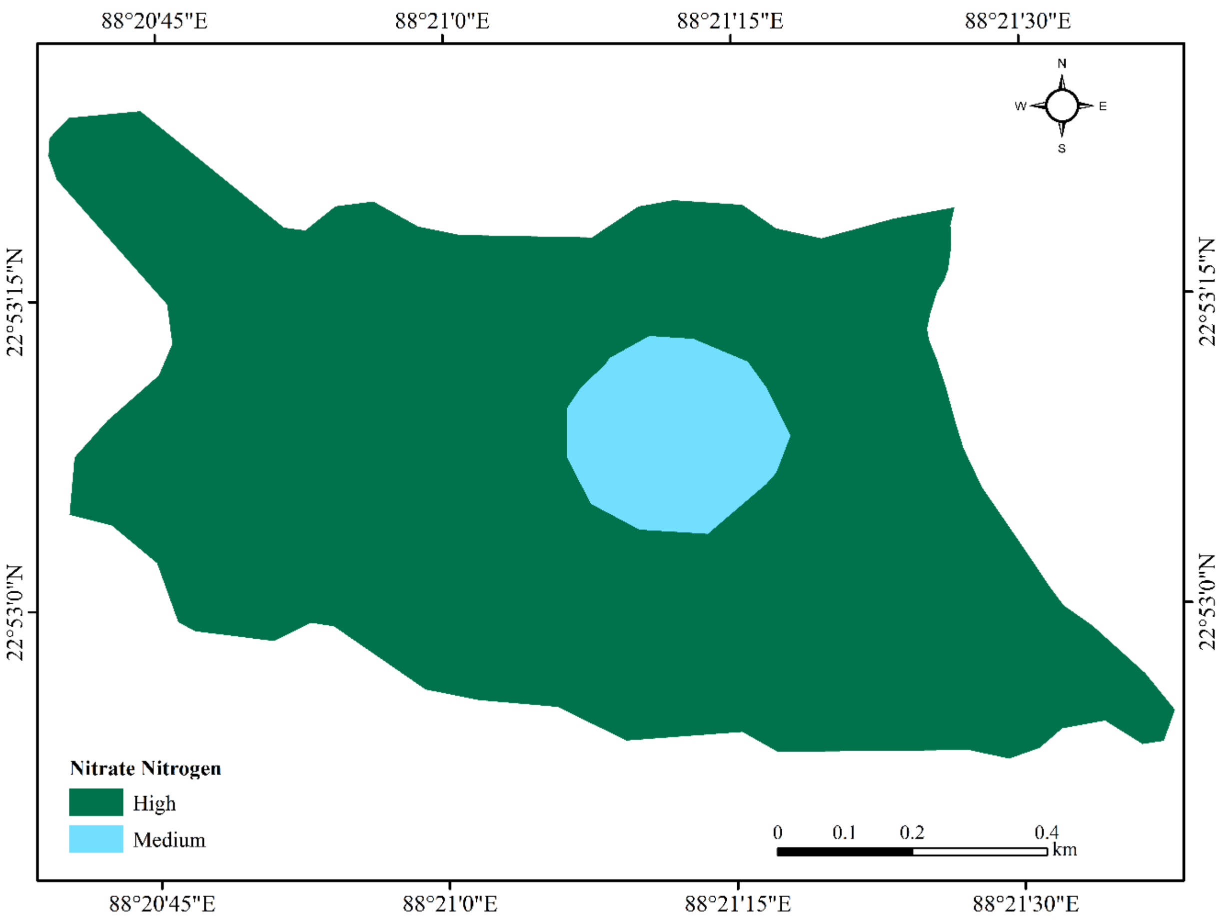

Fig.6.4. Soil Nitrate Nitrogen

6.1.5 Ammoniacal Nitrogen status

By urea after being applied to the soil Nitrogen fertilizer (mainly urea) is decomposed into ammonia nitrogen. By plants a part of the applied ammonia nitrogen can be directly absorbed and it can also be utilized while through the nitrification process a small amount of ammonia nitrogen is converted into NO3− and is absorbed by the soil. The world's second most produced chemical is Ammonia (NH3), which major use is as nitrogen (N) fertilizer. By the industry about 80% of the NH3 produced and it is used mainly in agriculture while for the fabrication of chemical compounds and explosives, the rest (20%) is used as raw material

For commercial fertilizers the Ammonia is produced and other industrial applications. Include the decomposition or breakdown of organic waste matter Natural sources of ammonia, gas exchange with the atmosphere, animal and human waste, forest fires and nitrogen fixation processes.

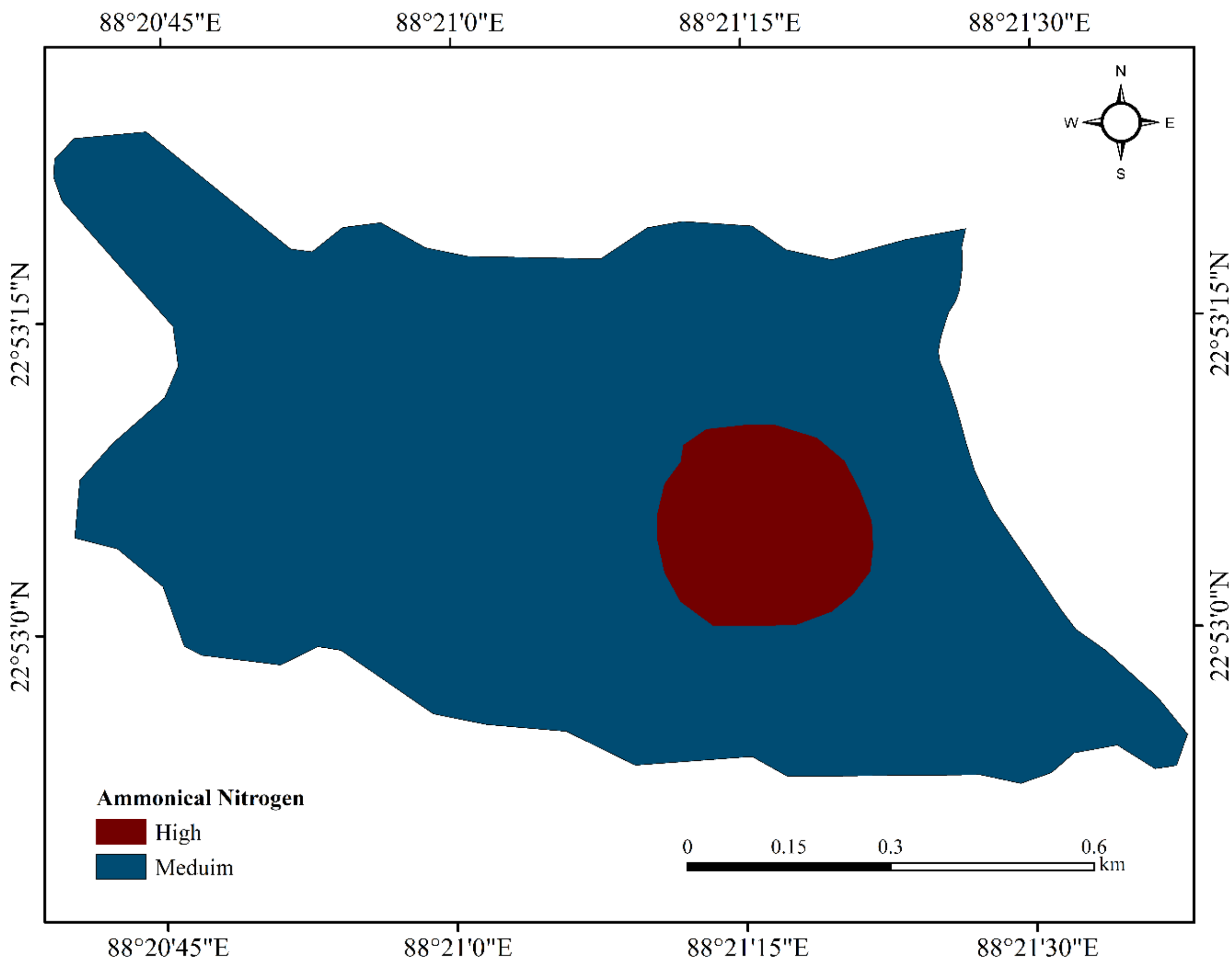

Fig.6.5. Ammoniacal Nitrogen

6.1.6 Potassium status

The potassium status of the soil of this Mouza ranges from low to very high. Generally, 57% area of the Mouza ranges from low to very high. Generally, 57% area of the Mouza (Central Upland and Western Lowland) K2O status of soil is not very satisfactory condition (low group).

The variability of potash status of soils in this area may be due to:

(A) Richness of the parent material in respect of K content status,

(B) Use of fertilizers,

(C) Many local causes, e.g. behavior of R. Saraswati during rainy seasons as we know higher the clay context higher the K content of the soil.

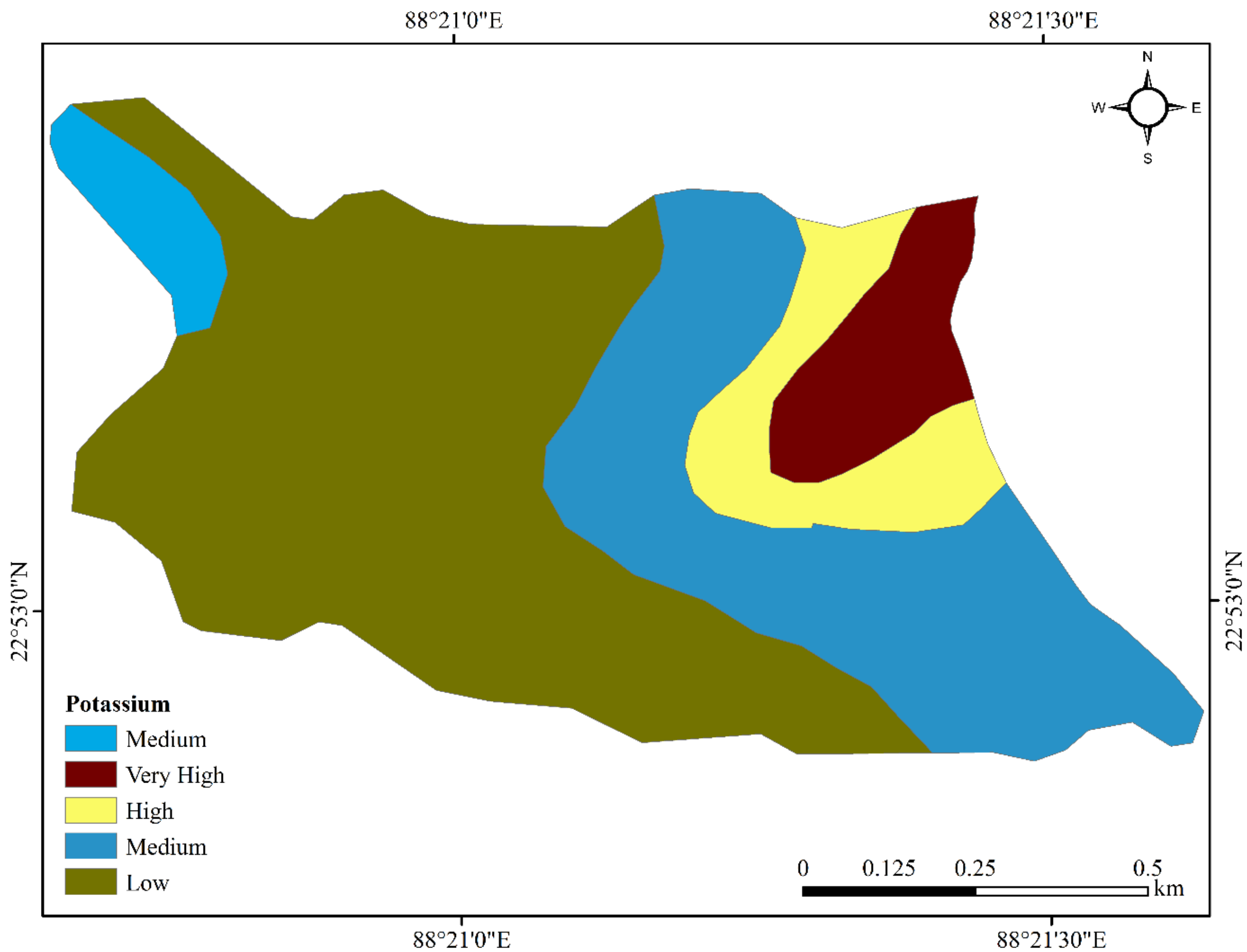

Fig.6.6. Potassium Status

6.1.7 Phosphate status

As compounds of phosphate ions Phosphates are usually used in combination with one or more common elements, such as calcium, sodium, potassium, and aluminum. Into several primary groups based on the number of phosphorus (P) molecules, Phosphates are classified. Factors such as soil compaction, insect pressure, herbicide injury and poor soil health also can cause phosphorus deficiency.

The P2O5 status of the soil of Amdabad Mouza ranges from low to high. Some parts of western lowland and central upland (38%) where p2o5 status is not reach in a remarkable position due to various physical and non-physical factors. Besides the remaining area, where p2o5 of soil is under of satisfactory group, is most satisfactory condition in term of plant growth. The total K content of soils frequently exceeds 20,000 ppm (parts per million). In soils while the supply of total K is quite large, for plant growth at any one time relatively small amounts are available.

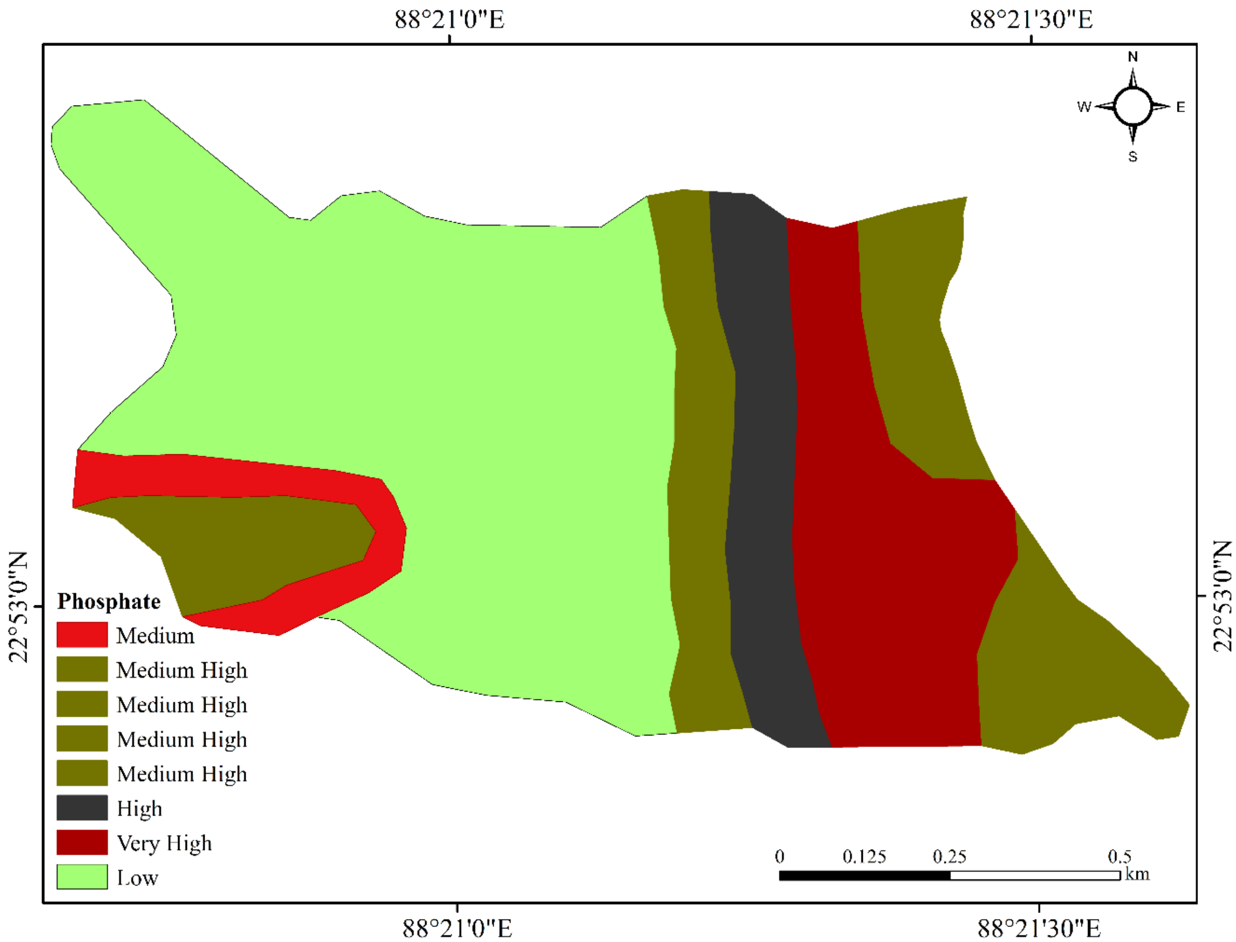

Fig.6.7. Phosphate Status

6.1.8 Nutrient status

Eastern part of the region of that Mouza are much more fertile in term of nutrient status due to availability of physical and chemical properties of soil and also supplying others minerals which enriched the region. This is due to flood plain of River Saraswati. Along the riverside area a small tracked agricultural landscape has been prevailed and others areas are utilized as orchard with inter-cultivation and residential area are also occupied along the main road of village. Availability of nutrient along the fringe of western part of Mouza are higher and these are also used as agricultural land as well as orchard with inter-cultivation and the remaining areas are under less or poor nutrient status. So, therefore western parts of that region are far from Saraswati River where older alluvial soil exists. Therefore, in this regards eastern part of that region with low land area are occupied by arable agriculture western part with lowland is under same characteristics. But the remaining area has modified the floodplain into a raised group which has been given to orchard, Bamboo, Ponds and residential houses etc.

Generally, nutrient status as well as well as fertile status of the Mouza is good in nature and the farmer are conscious to maintain the fertile status by soil using various fertilizers.

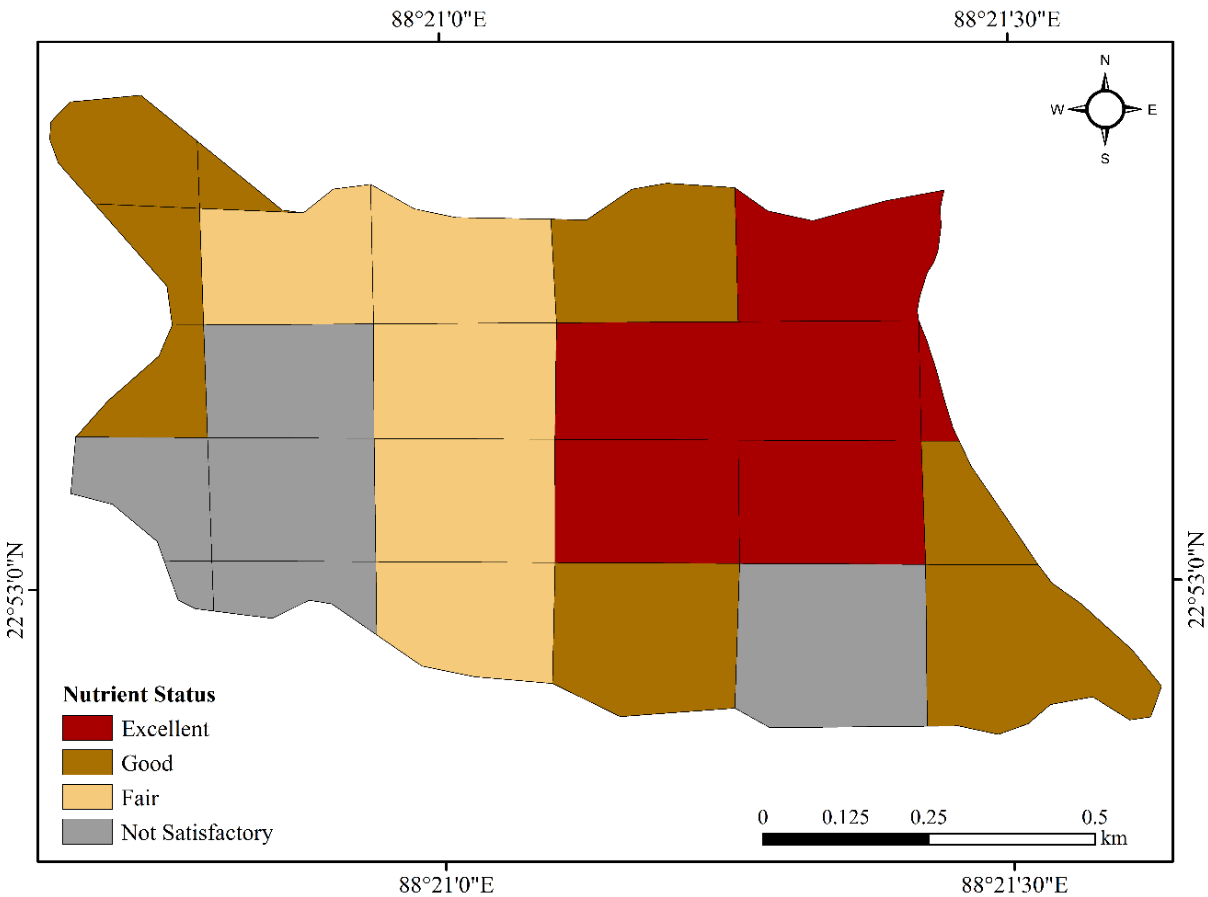

Fig.6.8. Nutrient Status

6.2 General landuse

The general landuse pattern of Amdabad Mouza is dominated by a special landuse type orchard. In terms of area, it is followed by arable land, bamboo groves, water bodies, residential land and finally waste land. It is defined as the order in which the crops are grown or cultivated over fixed period on a piece of land. The dominance of orchard is crucious. It appears that orchard provides better profit at lower cost than arable agriculture. The most interesting fact is that the orchard area has been increased in 2023(79%) than 1995(52%) and from 1992(47%). The settlement area has also been increased, but the arable agricultural area drops down from 30% to 15%.

6.2.1 Cropping pattern

Rice is the only one crop of this season due to heavy rains; high temperature and the water retentive clay loam soil preclude satisfactory performance of other crop than hygrophilous rice.

No less than arable agricultural land is under cultivation in the winter and is less than six general crops types have been recognized – rice, pulses, root crops (potato, onion, radish, kachu, beat) vegetables (spinach, brinjale, lady's finger, pea), wheat, oil seeds(mustered) etc.

In India have various food and non-food crops in three main cropping seasons which are cultivated which are rabi, Kharif, and Zaid. With the southwest monsoon the Kharif season starts and supports the cultivation of tropical crops.

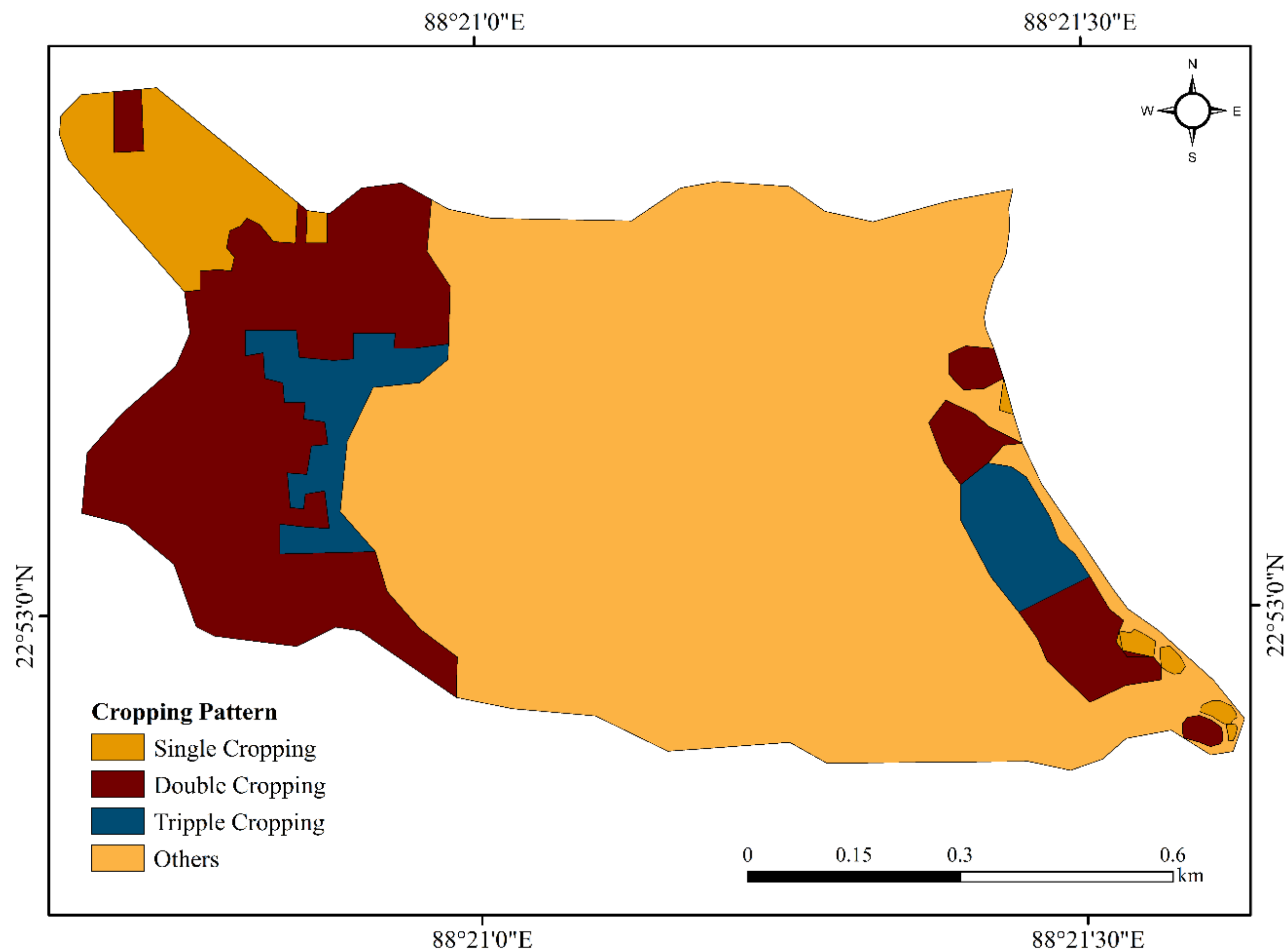

Fig.6.9. Cropping Pattern

The dominating trees is mango, followed by banana, papaya and litchi. The remaining four trees such as Jackfruit, Pine-apple, Coconut and Lime are of less important. There are few orchards with only one trees, many orchards contain two or more different types of trees together, such as mango, litchi, jack tree and banana etc.

6.2.2 Landuse landcover changing scenario

The various variations in pattern observed in the selected study area are based on a particular year of the particular subject taught. A special assessment of land use changes was made between 1992 and 1995 and 2023.

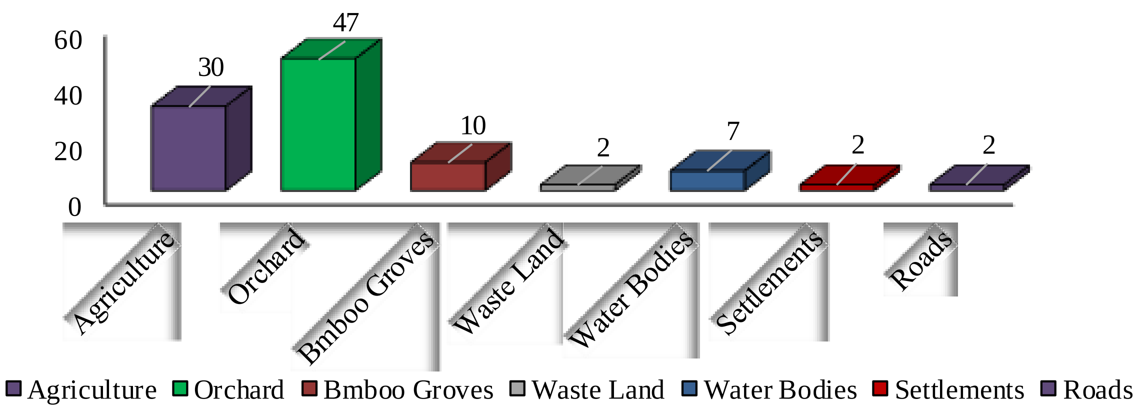

Fig.6.11. Area (%) under landuse type in the year 1992

Studying the different types of land use patterns in 1992, it was found that 30% of arable land and 47% of arable land in respect of the entire study area. Besides of these there have only 10%Bamboo groves, 2%waste lands, 7%water bodies and only 2%settlemets and roads.

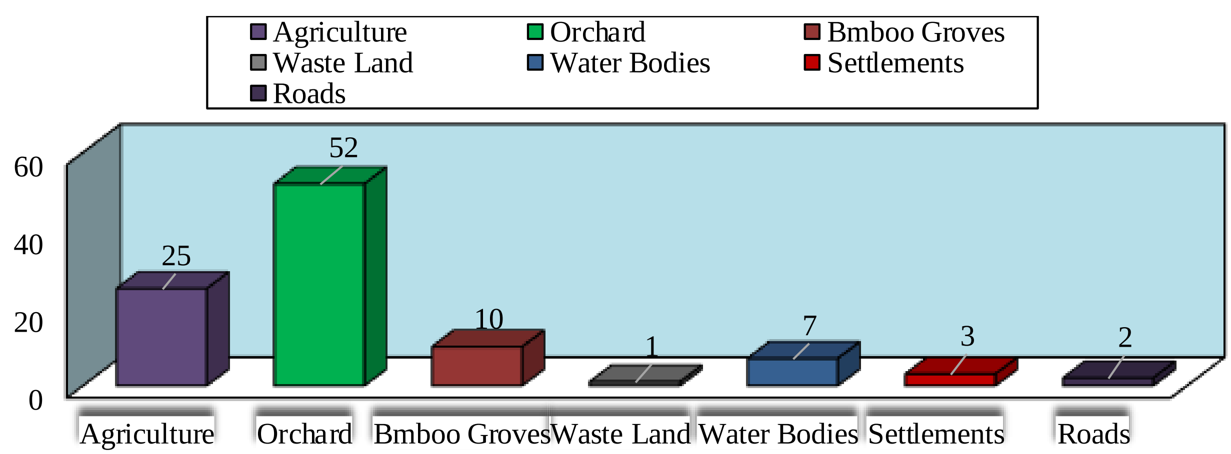

Fig.6.12. Area (%) under landuse type in the year 1995

In the year 1995 there have 25%agricultural land and 52%orchard. Besides, there have 10%Bamboo groves, 1%waste lands, 7%water bodies, 3%settlements and only 2% have roads.

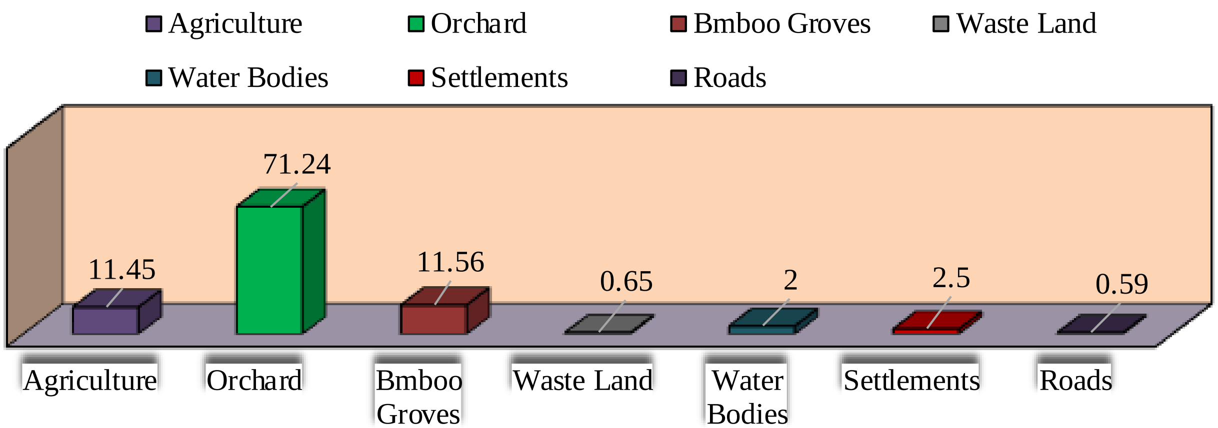

Fig.6.12. Area (%) under landuse type in the year 2023

In the year 2023 there have 13.45% agricultural land, 64.25% orchard, 14.56% have Bamboo Groves, 0.65% have waste land, 4% have water bodies, 2.5% have settlement areas and only 0.59% have road area.

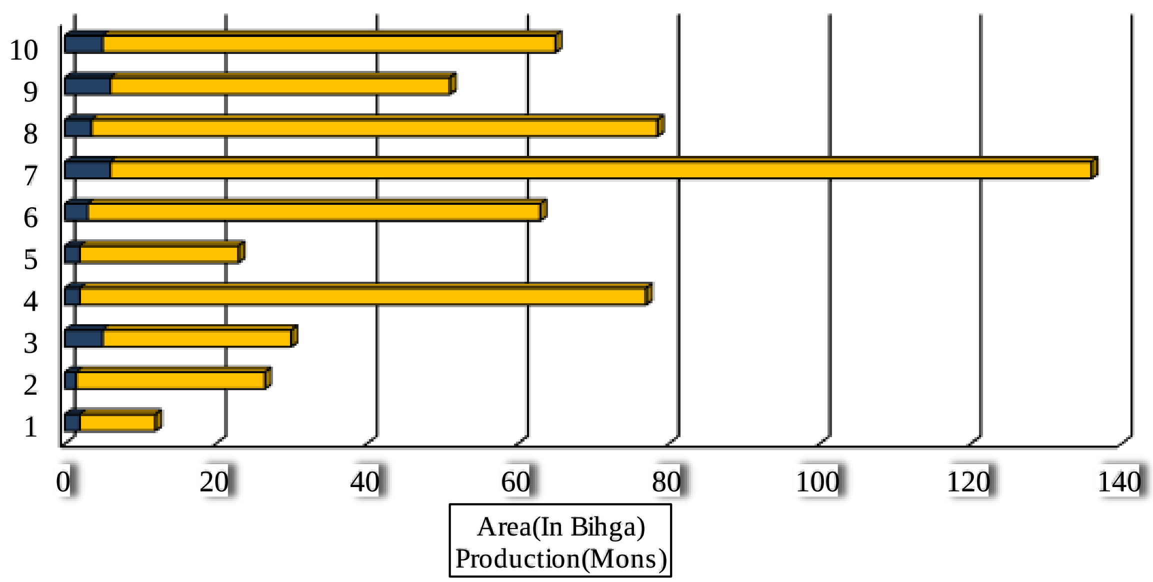

Fig.6.13. Area (Bihga) and production (Mons) of paddy in 2023

A special focus has been drawn on the area under paddy cultivation and also a significant analysis has been made on the quantity of paddy produced.

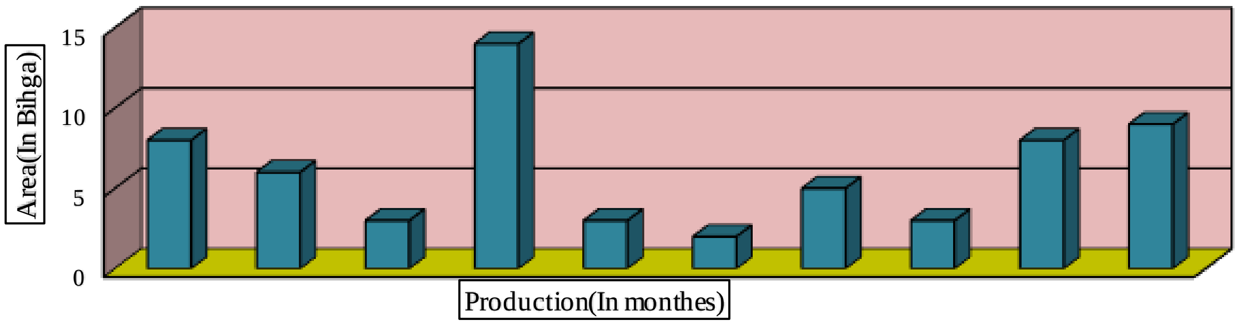

Fig.6.14. Area under cultivation of Mango Orchard in May, 2022 to Feb, 2023 in different sectors of the study area

Here is a special documentary about mango production mainly in the study area. A particularly significant analysis has been done on the quantity of mangoes produced per Bihga per month.

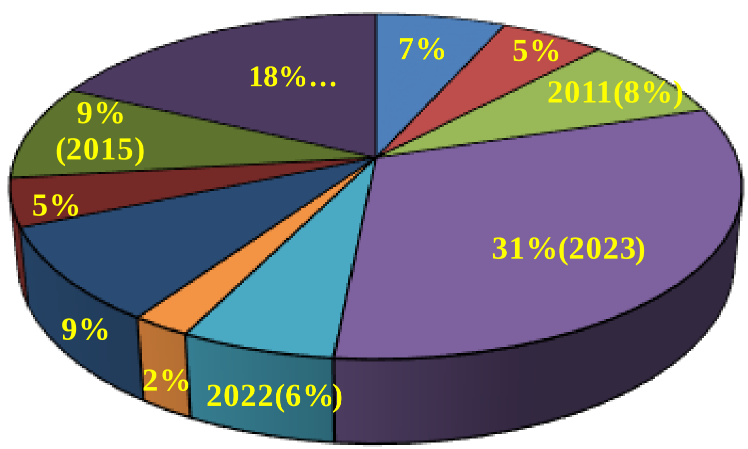

Fig.6.14 Production of Mango Orchard in last ten years from present

A significant document of the annual production of mangoes in kg is represented by diagram and it is seen that the production is increasing at a certain rate every year and from this it can be concluded that the extent of orchard cultivation is increasing every year. As it is progressing significantly, it is expected to reach a higher level in the coming days. So, all in all the future trend line of orchard cultivation is expected to be more upward.

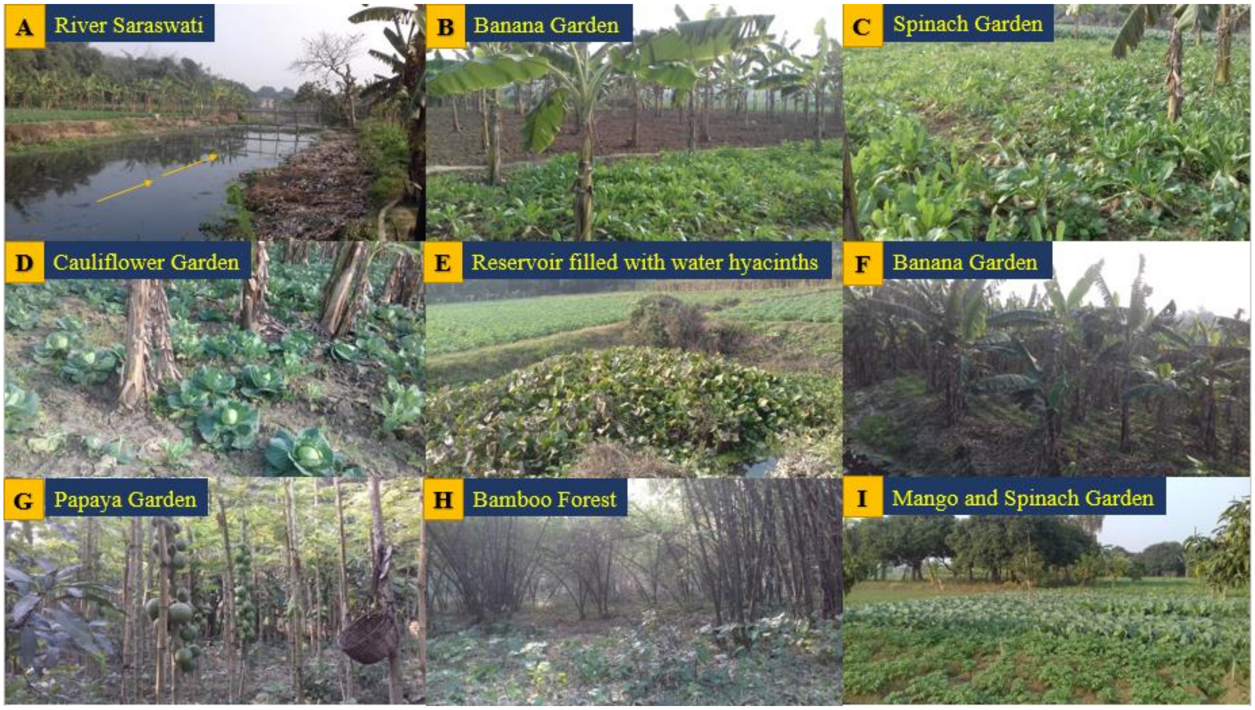

Fig.6.14. Scenario of orchard cultivation at Amdabad Mouza

A pilot survey has been conducted in the entire study area and a verbal survey has been conducted about the changes that have taken place along with the photographs that have been taken and a special aspect of the selected study area is highlighted through the above diagram.

7.0 Conclusion

Detailed study of the soil character and landuse pattern of Amdabad Mouza and its physical and cultural environment indicate how man can utilize natural resources and also modify them to develop at prosperous economy. The nature has occurred the people of Amdabad a fertile but low flood plain with soils of fine texture and a seasonal climate. Man has partly utilized a part of the flood plains for seasonal crops. He has modified the remaining flood plain into a raised ground with soil of loamy texture which has been given to orchard, bamboo, fruits. If a long-term land use change is observed, it will be seen that the type of cultivation that was done in the past is no longer practiced there, i.e. the land use change is attracting a special attention. This issue has been highlighted through the above project and it has basically been shown that mango orchard production from 8% in 2011 to 31% in 2023 is one of the huge changes observed not only in mango but also in different types of orchard cultivation Therefore this phased change in land use is discussed and reviewed from different perspectives and a conclusion is drawn.

8.0 Limitation, Problems and remedial measures

In this chapter the findings of our study have been enumerated below alone with remedial measured to overcome the mouza constraints for proper land utilization of the area, the problem is stated here briefly.

1. Inadequacy of some required data we have restricted the scope of study.

2. Sometimes soil sample collection was not accurately maintained due to some obstacles like's ponds, trees, houses, bricks roads etc.

3. In Arable agriculture land where in N.P.K. status of soil of this mouza are excellent, but productivity is low. This may cause due to indiscriminate use of chemical fertilizers.

4. In orchard area, where N.P.K. status is not reach in a satisfactory level.

5. It is interesting to note that sometimes the Saraswati river cause floods in Eastern lowlands of the study area.

6. Low quality supply of seeds in time of showing results low yield rate.

7. Cost of fertilizers are increasing day by day and it is beyond the reach of the poor farmers.

8. The areas from where the roads are conspicuously absent are the Western and Eastern agriculture lowland where arable agriculture is practiced.

9. Their tenacity has gradually been increasing towards orchard.

10. They are highly interest in increasing the Orchard area through raising the flood plain area mainly in western lowland with soils of loamy texture. But these are very much expensive to them.

11. Some problems have been observed regarding the collection of various types of data from the field survey in the study area.

9.0 Acknowledgement

We are highly thankful to local people, farmers, and administrative members for continuous support to complete our research paper in a systematic way.

10.0 References:

Bååth, E., Anderson, T.H., 2003. Comparison of soil fungal/bacterial ratios in a pH gradient using physiological and PLFA-based techniques. Soil Biology and Biochemistry 35, 955–963.

Bååth, E., Frostegård, A., Pennanen, T., Fritze, H., 1995. Microbial community structure and pH response in relation to soil organic-matter quality in woodash fertilized, clear-cut or burned coniferous forest soils. Soil Biology and Biochemistry 27, 229–240.

Bossio, D.A., Scow, K.M., Gunapala, N., Graham, K.J., 1998. Determinants of soil microbial communities: effects of agricultural management, season, and soil type on phospholipid fatty acid profiles. Microbial Ecology 36, 1–12.

Bossuyt, H., Denef, K., Six, J., Frey, S.D., Merckx, R., Paustian, K., 2001. Influence of microbial populations and residue quality on aggregate stability. Applied Soil Ecology 16, 195–208.

Carlile, M.J., Watkinson, S.C., Gooday, G.W., 2001. The Fungi. Academic Press, San Diego.

Coppin, P., Jonckheere, I., Nackaerts, K., Muys, B., & Lambin, E. (2004). Digital change detection methods in ecosystem monitoring: a review. International Joumal of Remote Sensing, 25, 1565e1596.

Eastman, J. R. (2009). IDRISI guide to GIS and image processing Accessed in IDRISI Selva 17 (pp. 182e185). Worcester, MA: Clark University.

Eastman, J. R. (2012). IDRISI selva. Worcester, MA: Clark University.

Freier, K. P., Schneider, U. A., & Finckh, M. (2011). Dynamic interactions between vegetation and land use in semi-arid Morocco: using a Markov process for modeling rangelands under climate change. Agriculture, Ecosystems and Environment, 140, 462e472.

Frostegård, A., Bååth, E., Tunlio, A., 1993. Shifts in the structure of soil microbial communities in limed forests as revealed by phospholipid fatty acid analysis. Soil Biology and Biochemistry 25, 723–730.

Guan, D., Li, H., Inohae, T., Su, W., Nagaie, T., & Hokao, K. (2011). Modeling urban land use change by the integration of cellular automaton and Markov model. Ecological Modelling, 222, 3761e3772.

Guan, D., Li, H., Inohae, T., Su, W., Nagaie, T., & Hokao, K. (2011). Modeling urban land use change by the integration of cellular automaton and Markov model. Ecological Modelling, 222, 3761e3772.

Heinemeyer, A., Ridgway, K.P., Edwards, E.J., Benham, D.G., Young, J.P.W., Fitter, A.H., 2004. Impact of soil warming and shading on colonization and community structure of arbuscular mycorrhizal fungi in roots of a native grassland community. Global Change Biology 10, 52–64.

Hendrix, P.F., Parmelee, R.W., Crossley, D.A., Coleman, D.C., Odum, E.P., Groffman, P. M., 1986. Detritus food webs in conventional and no-tillage agroecosystems. Bioscience 36, 374–380.

Johnson, M.J., Lee, K.Y., Scow, K.M., 2003. DNA fingerprinting reveals links among agricultural crops, soil properties, and the composition of soil microbial communities. Geoderma 114, 279–303.

Lambin, E. F. (1997). Modelling and monitoring land-cover change processes in tropical regions. Progress in Physical Geography, 21, 375e393.

Lu, D., Mausel, P., Brondizio, E., & Moran, E. (2003). Change detection techniques. International Journal of Remote Sensing, 25, 2365e2401.
Menon, S., Jr., GP, R., Rose, J., Khan, M. L., & Bawa, K. S. (2001). Identifying a land-usein the conservation-priority areas Tropics: change modeling approach. Conservation Biology, 15, 501e512.

Murty, D., Kirschbaum, M.U.F., McMurtrie, R.E., McGilvray, A., 2002. Does conversion of forest to agricultural land change soil carbon and nitrogen? A review of the literature. Global Change Biology 8, 105–123.

Overmars, K. P., de Koning, G. H. J., & Veldkamp, A. (2003). Spatial autocorrelation in multi-scale land use models. Ecological Modelling, 164, 257e270.

Ovreas, L., Torsvik, V., 1998. Microbial diversity and community structure in two different agricultural soil communities. Microbial Ecology 36, 303–315.

Pijanowski, B., Brown, D., Shellito, B., & Manik, G. (2002). Using neural networks and GIS to forecast land use changes: a land transformation model. Computers, Environment and Urban Systems, 26, 553e575.

Post,W.M., Mann, L.K., 1990. Changes in soil organic carbon and nitrogen as a result of cultivation. In: Bowman, A.F. (Ed.), Soil and the Greenhouse Effect. Wiley, New York, pp. 401–407.

Rogan, J., & Chen, D. (2004). Remote sensing technology for mapping and monitoring land-cover and land-use change. Progress in Planning, 61, 301e325.

Rogan, J., & Chen, D. (2004). Remote sensing technology for mapping and monitoring land-cover and land-use change. Progress in Planning, 61, 301e325.

Sala, O. E., Chapin, F. S., III, Armesto, J. J., Berlow, E., Bloomfield, J., Dirzo, R., et al. (2000). Global biodiversity scenarios for the year 2100. Science, 287, 1770e1774.

Sala, O.E., Chapin, F.S., Armesto, J.J., Berlow, E., Bloomfield, J., Dirzo, R., Huber- Sanwald, E., Huenneke, L.F., Jackson, R.B., Kinzig, A., Leemans, R., Lodge, D.M., Mooney, H.A., Oesterheld, M., Poff, N.L., Sykes, M.T., Walker, B.H., Walker, M., Wall, D.H., 2000. Biodiversity – global biodiversity scenarios for the year 2100. Science 287, 1770–1774.

Singh, A. (1989). Digital change detection techniques using remotely-sensed data. International Journal of Remote Sensing, 10, 989e1003.

Six, J., Frey, S.D., Thiet, R.K., Batten, K.M., 2006. Bacterial and fungal contributions to carbon sequestration in agroecosystems. Soil Science Society of America Journal 70, 555–569.

Steenwerth, K.L., Jackson, L.E., Calderon, F.J., Stromberg, M.R., Scow, K.M., 2002. Soil microbial community composition and land use history in cultivated and grassland ecosystems of coastal California. Soil Biology and Biochemistry 34, 1599–1611.

Theobald, D. M., & Hobbs, N. T. (1998). Forecasting rural land-use change: a comparison of regression- and spatial transition-based models. Geographical and Environmental Modelling, 2, 65e82.

Turner, B. L., Lambin, E. F., & Reenberg, A. (2007). The emergence of land change science for global environmental change and sustainability. PNAS, 104, 20666e20671.

Veldkamp, A., & Lambin, E. F. (2001). Predicting land-use change. Agriculture, Ecosystems and Environment, 85, 1e6.

Veldkamp, A., & Lambin, E. F. (2001). Predicting land-use change. Agriculture, Ecosystems and Environment, 85, 1e6.

Wickramasuriya, R. C., Bregt, A. K., van Delden, H., & Hagen-Zanker, A. (2009). The dynamics of shifting cultivation captured in an extended constrained cellular automata land use model. Ecological Modelling, 220, 2302e2309.

Wu, Q., Li, H., Wang, R., Paulussen, J., He, Y., Wang, M., et al. (2006). Monitoring and predicting land use change in Beijing using remote sensing and GIS. Landscape and Urban Planning, 78, 322e333.

Zelles, L., Bai, Q.Y., Beck, T., Beese, F., 1992. Signature fatty-acids in phospholipids and lipopolysaccharides as indicators of microbial biomass and community structure in agricultural soils. Soil Biology and Biochemistry 24, 317–323.