Chapter 4 Status of agro-natural resource production and its' utilization

4.1. Introduction

The economy of India is mostly based on agriculture and any change in the agricultural landuse pattern which has important implication on its growth and sustainability (Kumari, 2014). India is a fast growing country in terms of population growth. As a result, there is more population pressure on agriculture. Therefore, the agricultural landuse pattern is changing to meet the needs of more peoples.

The communication system of Purba Medinipur district is quite developed. With the same, the labour and demand is also high. In this context, the nature of agro-natural resources utilization of the district is the significant factor for economic development. Although, the motives and nature of resource utilization depend on human intelligence, technology, infrastructure and awareness. This chapter explained the nature of agricultural landuse, amount of crop production and its trend, use of crops and forest resources. The study also discusses the environmental assessment in terms of growth of fisheries. All the analysis has been performed in GIS platform.

4.2 Nature of agricultural landuses

Agricultural land includes arable land, permanent crops and permanent pastures and it is commonly expressed as a percentage of land area out of total geographical unit (FAO). Arable land is the agricultural land where crops are cultivated with the temporary agricultural crops. Seasonal crop cultivation is done in this land. Permanent crop land is the sowing land where once the crops are planted and occupy the land for long periods, such as cocoa, coffee, betel leaf etc. Permanent pastures refer to land used permanently to grow grasses or other herbaceous forage crops either naturally or through cultivation. There are two types of

agricultural landuses are found in the district. One is the arable land, also called cultivated land and other is permanent crop land. Generally, permanent crop land is used for social as well as agro-forestry in the district.

4.2.1. Cultivated land and other landuse

Purba Medinipur district composed of 406100.25 hectares of land. Total cultivated land of the district is 288009.14 hectares according to 2015-16 agricultural report published by all Block Agriculture Office of the district. So, the amount of other land uses is 118091.11 hectares. Other landuse of the district is forest land, built up area, wetland, and water body.

In this district the amount of cultivated land in every village is high. The map (Fig. 4.1) represents the village wise distribution of percentage of cultivated land of Purba Medinipur district (Annexure 5). All the villages have been categorized into five classes with equal interval. There are 39 percent villages where the amount of cultivated land is above 80 percent out of total geographical area. This type of villages is mostly located in the blocks of Patashpur-I & II, Egra-II, Desopran, Contai-I & III, Nandigram-II, Khejuri-I & II, Bhagawanpur-I, Chandipur and Mahisadal. Near about 45 percent villages of the district have their 60 to 80 percent cultivated land of their total geographical area. The number of villages in this category is 1371 and it is found more or less to all the blocks of the district. Especially, it is largely found in the northern blocks of the district such as Mayna, Panskura, Kolaghat, Sahid Matangini, Tamluk, Nandakumar etc. Besides, there are also 10 percent villages of which 40 to 60 percent area is cultivated land and 4 percent villages of which 20 to 40 percent is cultivated land. In 2 percent villages, the amount of cultivated land is less than 20 percent (Table 4.1).

Table 4.1 Different classes of cultivated land with number of village, 2015-16.

Percentage of cultivated land	Number of village
Above 80	1171
60 - 80	1353
40 - 60	307
20 - 40	114
Below 20	54

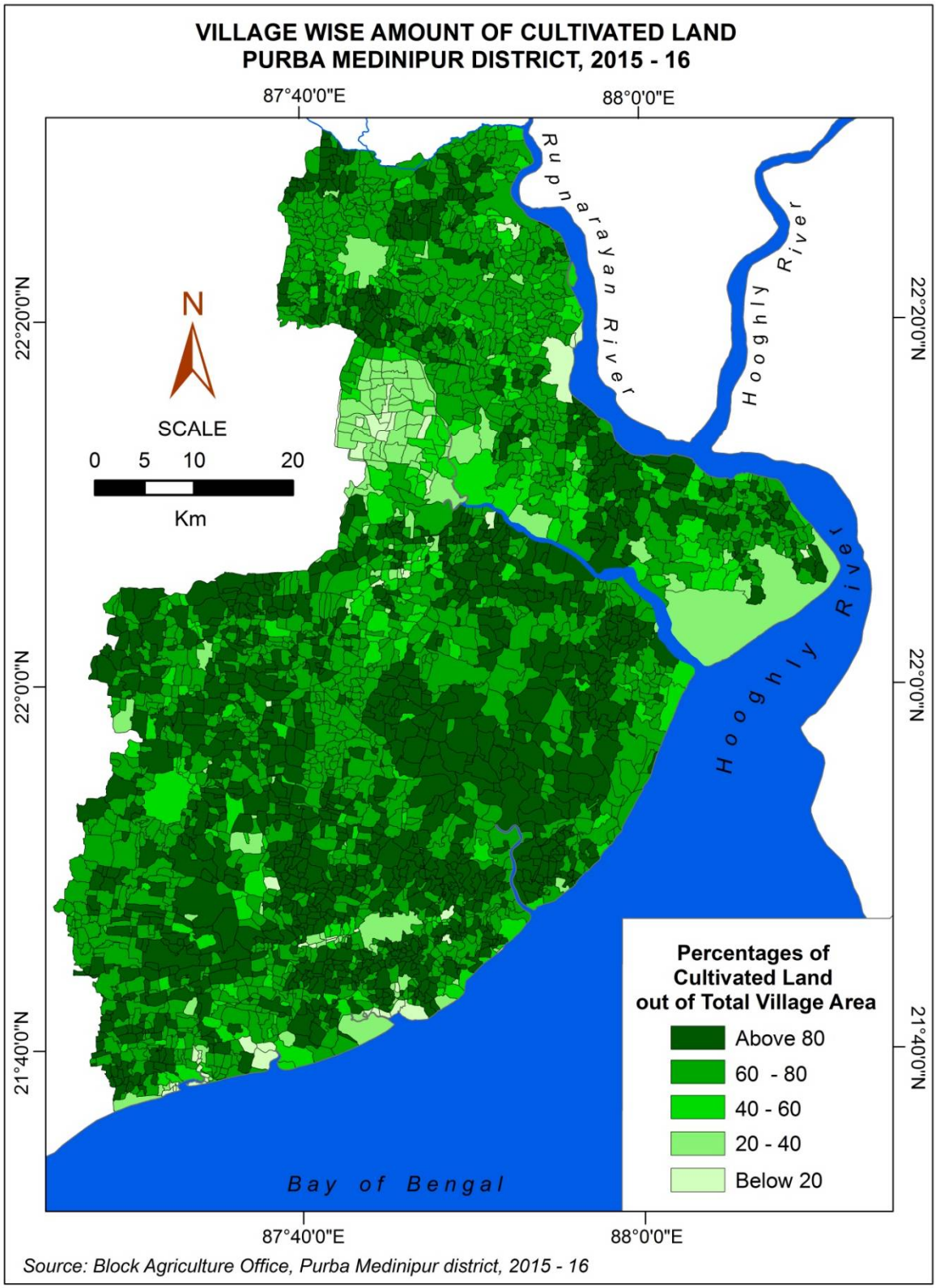

Fig. 4.1 Village wise percentage of cultivated land.

4.2.2. Seasonal nature of agricultural landuse

The seasonal nature of agricultural land use and in relation to its controlling factors provides essential information for sustainable management of agricultural landuse (Kumari, 2014). So, for the present study it is necessary to discuss about seasonal pattern of agricultural landuse of the district. In Purba Medinipur district, near about 80 percent villages have cultivated land above 60 percent of their total geographical area. But the amount of seasonal use of cultivated land is varied in different season. The agriculture of Purba Medinipur district is mainly done on three main seasons, such as the rainy season, winter season and summer season. During these three seasons, different amount of cultivated land remains unploughed which is called non ploughed arable land. Non ploughed arable land is a land which is cultivable, but presently not used for cultivation for any reasons. The table 4.2 shows the number of villages in different seasons in different categories of non-ploughed arable land and also the table 4.4 shows the amount of non-ploughed arable land in different seasons. Four maps (Fig. 4.2, 4.3, 4.4, 4.5) have been prepared to show the village wise amount non-ploughed arable land in which first three maps are prepared seasonally based and other is gross. The class range of three maps is based on equal interval of the dataset.

A. Non ploughed arable land in Kharif season:

Kharif season, commonly known as the rainy season is the best season for crop cultivation in the district. Because, availability of rain water throughout the district helps to grow more crops. Therefore, most of the arable land is used for crop cultivation during this season (Fig. 4.2). Very small land is not ploughed during this time and near about 70 percent of the villages have the amount of non-ploughed arable land less than 20 percent of their total arable land. There are only 43 villages where the amount of non-ploughed arable land is above 80 percent (Table 4.2). Total non-ploughed arable land of the district in this season is 42027.76 hectares out of total 288009.14 hectares of cultivated land.

B. Non ploughed arable land in Rabi season:

The rabi crop period is also known as winter dry season. Therefore, the amount of non-ploughed arable land is more in most of the villages of the district during the rabi season (Fig. 4.3). Total non-ploughed arable land of the district during this season is 249895.5 hectares out of total arable land 288009.14 hectares. There are 44 percent villages of which more than 80 percent of the total arable land does not used for cultivation during this season. Most of the villages in Egra-I & II, Patashpur-I & II, Bhagawanpur-I, Sahid Matangini, Tamluk, Nandakumar and Mahisadal block have the highest amount of non-ploughed arable land. In 45 percent villages of the district, 60 to 80 percent of their total arable land remains vacant which belong to the blocks of Ramnagar-I and II, Contai-I and II, Desopran, Khejuri-I and II, Nandigram-I and II, Chandipur, Bhagwanpur-II and Haldia etc.

C. Non ploughed arable land in Zaid season:

The total amount of non-ploughed arable land of the district is about 181286.99 hectares in zaid crop season. In 50 percent villages of the district, the amount of non-ploughed arable land is above 60 percent out of their total arable land. Among this category, most of the villages is located on coastal block of the district, like Haldia, Nandigram-I & II, Ramnagar-II, Desopran, Contai-I & II, Khejuri-I & II, as well as Egra-I block. The amount of non ploughed arable is 20 to 60 percent in 41 percent villages of the district belongs to the mostly in northern and eastern blocks. The map (Fig. 4.4) shows the village wise amount of non-ploughed arable land during zaid season.

D. Gross non ploughed arable land:

The gross non ploughed arable land of each village has been determined by adding three seasons' percentages of non ploughed arable land out of total 300 percent arable land of the three seasons and a gross map (Fig. 4.5) of non ploughed arable land is made. The class division of the map has been determined based on equal interval of the dataset and considered

it into the round value. The map shows that the villages of southern and western blocks of the district have the high percentages of gross non ploughed arable land. Near about 17 percent villages of the district have more than 200 percent gross non ploughed arable land which located on the blocks of Contai-I Desopran, Chandipur etc. In addition, 45 percent villages of the district also have 150 to 200 percent non ploughed arable land which is mostly located in the Ramnagar-I and II, Egra-I and II, Patashpur-II, Bhagwanpur-I and II Khejuri-I and II, Nandigram-I and II, Contai-II and Chandipur blocks. The amount of non ploughed arable land in 29 percent villages mostly in the northern and eastern blocks like Kolaghat, Sutahata, Sahid Matangini, Mahisadal, Tamluk and Nandakumar is 100 to 150 percent. There are 9 percent villages which have non ploughed arable land less than 100 percent and mostly belong to the Panskura and Mayna block (Annexure 6). The table 4.3 shows the classes of gross non ploughed arable land and the number of villages in that classes.

Table 4.2 Different category of non ploughed arable land with number of village in different season, 2015-16

Percentage of Non Ploughed Arable Land	Number of village (Kharif Season)	Number of village (Rabi Season)	Number of village (Zaid Season)
Above 80	43	1311	650
60 - 80	31	1356	841
40 - 60	345	130	596
20 - 40	495	94	631
Below 20	2085	108	281

Table 4.3 Classes of gross non ploughed arable land with number of village, 2015-16

Percentage of Gross Non Ploughed Arable Land	Number of Village
Above 200	499
150 - 200	1356
100 - 150	871
Below 100	273

Table 4.4 Amount of non ploughed arable land in different crop season, 2015-16

Crop seasons	Area under non ploughed arable land (Hectare)
Kharif	42027.76
Rabi	249895.5
Zaid	181286.99
Gross	473210.25

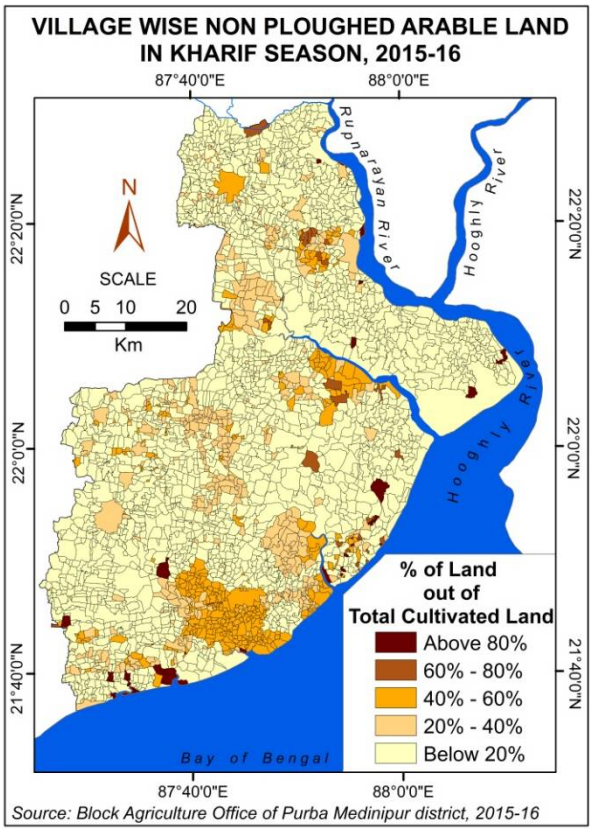

Fig. 4.2 Percentage of non ploughed arable land of Purba Medinipur district in kharif season.

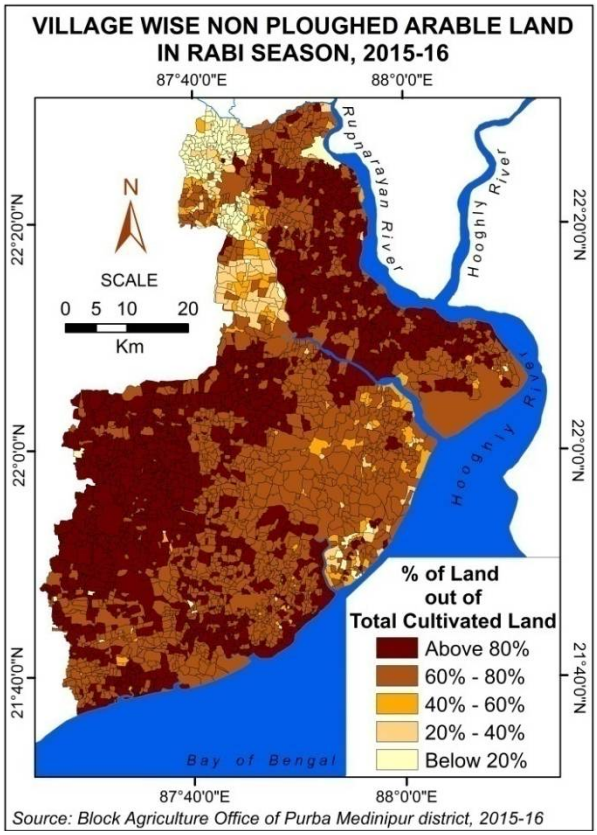

Fig. 4.3 Percentage of non ploughed arable land of Purba Medinipur district in rabi season.

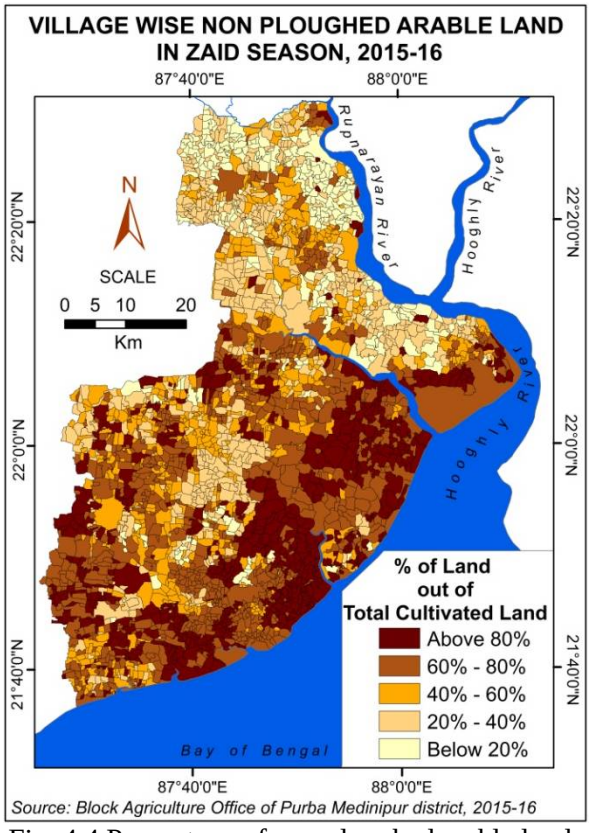

Fig. 4.4 Percentage of non ploughed arable land of Purba Medinipur district in zaid season.

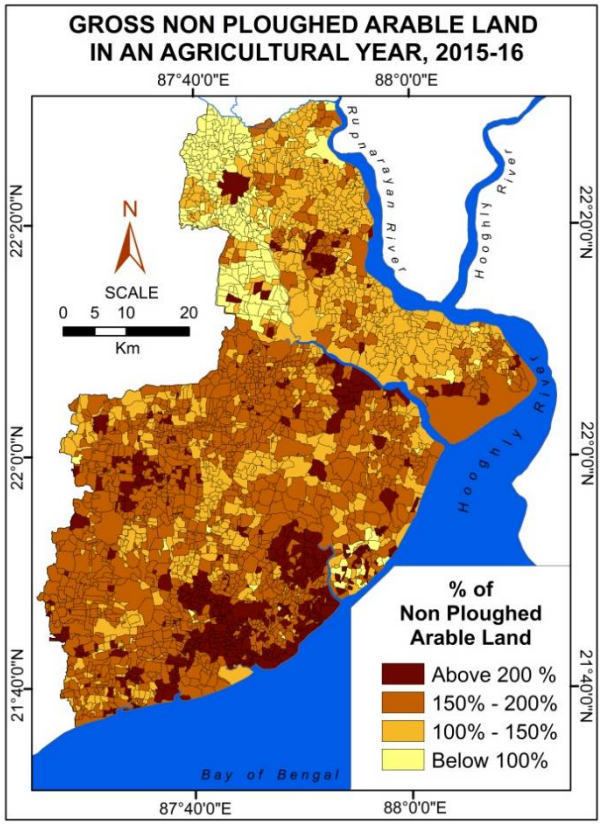

Fig. 4.5 Percentage of gross non ploughed arable land of Purba Medinipur district.

4.2.3. Cropping pattern and landuse

The cropping pattern means the variation in the areal proportion under different crop cultivation at a point of time in an area. The quantitative measurement of crop distribution in a place can be analysed by the cropping pattern. Therefore, the cropping pattern can be described as an areal statistics (Vijayalakshmi, 2017). Evolution of cropping pattern depends on the decisions made by the farmer. So, the cropping pattern is a dynamic approach which is changed over a space and time. The cropping pattern is controlled by physical, socio-cultural, economical and political factors. On the other hand, land use is a geographical concept which indicates the engagement of land in different activities such as agriculture, pisciculture, forest, pastures, transportation, residential, recreational, industrial and commercial etc. Among them, agriculture is one of the important landuse activity. Agricultural land is used basically for production of different crops mainly food grain production. However, the nature of agricultural land use varies from region to region depending on the geographical environment as well as social and cultural characteristic and the nature of demand. The efficient use of agricultural land depends on the ability of man to use the land for suitable perspectives. The use of agricultural land and its efficiency are characterized by cropping pattern.

The nature of agricultural resource management is multidimensional. It includes a variety of aspects such as agricultural land utilization, cropping intensity, crop combination, crop diversification, nature of agrarian relationship and so on (Vijayalakshmi, 2017). So, it is necessary to quantitative measure of these aspects to understand the physical and human interaction of an area.

4.2.3.1 Cropping Intensity

The production and productivity of agriculture can be enhanced in two ways, one is to increase the cropped area and the other is to increase the intensity of cropping. In the district,

physically suitable land for cultivation is already under plough. So, there is minimum scope to increase the net sown area. But, agricultural production and productivity can be enhanced by the increasing of cropping intensity. Cropping intensity refers the growing of a number of crops on a same land during an agricultural year. Cropping intensity indicates the enhancement to which the unit of a particular area is used for various crop productions (Jegankumar et al., 2015). Therefore, the higher cropping intensity means that the use of net sown area is maximum and multiple purposes and the net sown area is cultivated more than once during one agricultural year. It is the ratio between gross cropped area and the net cropped area. It can be expressed as,

Formula: $\frac{GCA}{NCA}$ **x 100**

Where,

GCA= Gross Cropped Area
NCA =Net Cropped Area

Cropping intensity has been estimated for each village of the district by using above formula and all the villages has been categorised into three classes such as high, medium and low (Table 4.5). The classes of cropping intensity has been determined based on mean and standard deviation of the data set and considered the round figure of the class value. The map (Fig. 4.6) represents the village wise cropping intensity of Purba Medinipur district where 1091 villages are belongs to the high, 1369 villages to the medium and 539 villages to the low cropping intensity out of total 2999 villages of the district. Most of the high cropping intensity villages are located on the Panskura, Mahisadal, Kolaghat, Nandakumar, Mayna and Sahid Matangini block. Near about 46 percent villages of the district are under the medium cropping intensity and it distributes more or less to all blocks in southern and western part of the district. The low cropping intensity is found in the 18 percent villages of which majority is located in the Contai-I, Desopran, Chandipur, Ptashpur-II and Egra-I block (Annexure 7).

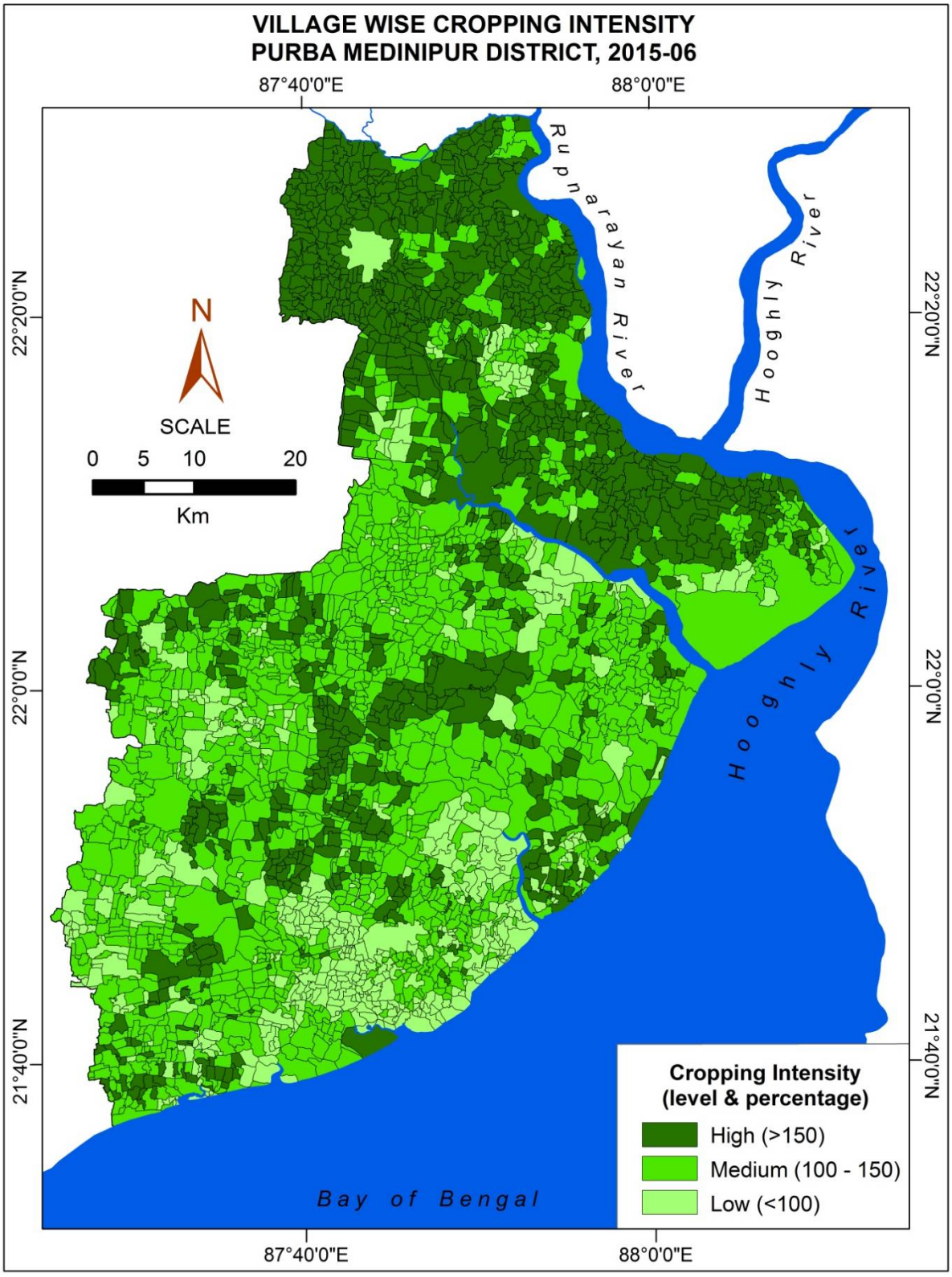

Fig. 4.6 Spatial variability of cropping intensity of Purba Medinipur district.

Table 4.5 Classes of cropping intensity with number of village.

Cropping Intensity (%)	Number of village
Low (<100)	539
Medium (100 - 150)	1369
High (>150)	1091

From the map (Fig. 4.7), it is observed that there is a close relation of cropping intensity with soil types. The high cropping intensity areas are geologically made up of younger alluvial soil. In areas of coastal alluvial, older alluvial, saline and saline alkali soil, the intensity is low.

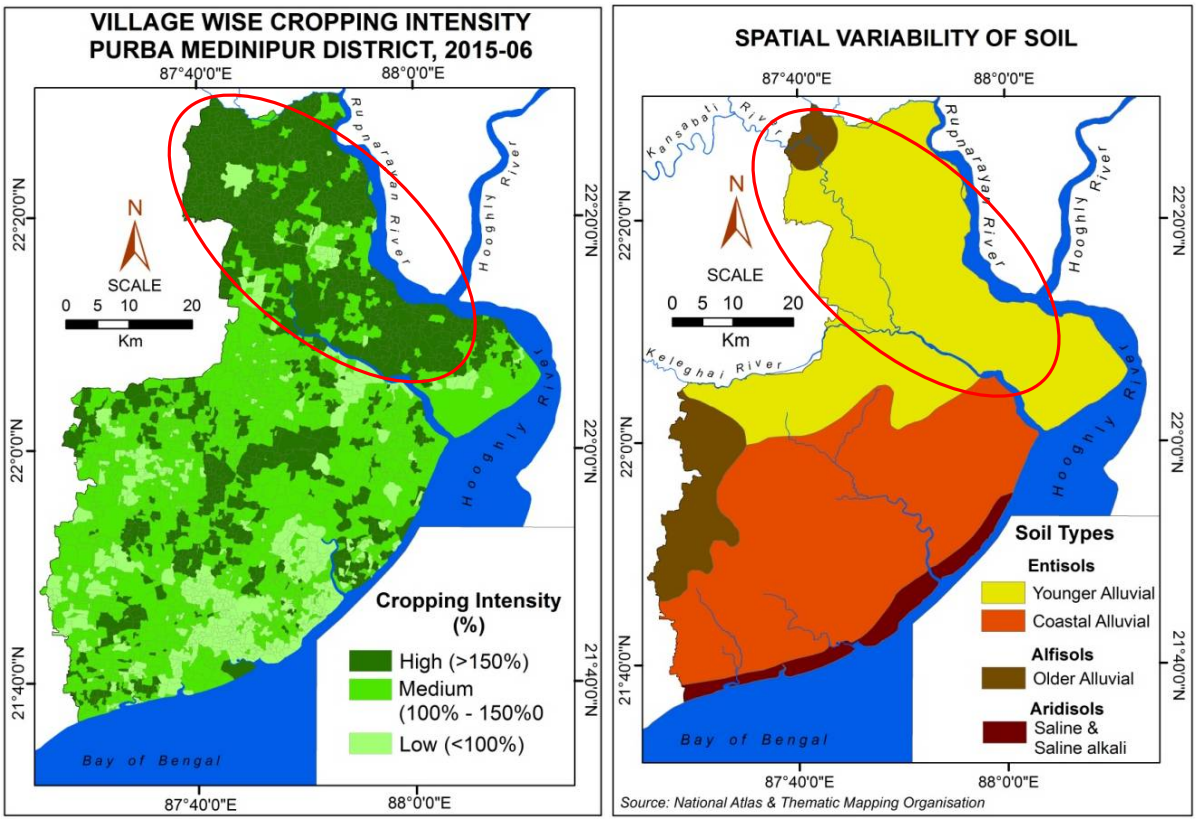

Fig. 4.7 Relation of cropping intensity with soil types in Purba Medinipur district

4.2.3.2 Crop Combination

Crop combination is the number of crops grown in a particular area during an agricultural year. Crop combination indicates the cultivation of varieties of crops in a same field in different season. Study of crop combinations has greater significance, because it reflects the importance of different crops and position of the crops within themselves. It also

deals about some economic and social aspect of the region (Kumar, 2017). Crop combination has an significant role in agricultural process and development. The repeated cultivation of the same crop in a same field can arise single nutrient deficiency problem in the soil. But crop combination removes this deficiency of nutrient by growing different types of crop across the period for long times. For example, crop combination with legume can help the soil enriched in nitrogen. Crop combination can meet the needs of different crops with increasing demand.

There are many statistical methods for crop combination analysis. Among the statistical method, J.C Weaver's (1954) multifactor approach has been applied in this study. J.C Weaver first used this statistical technique to show the crop combination of the Middle West (U.S.A). In his work, Weaver calculated the deviation of actual percentage of crops and compared with the theoretical percentage. For monoculture crop with 100 percent, double crops with 50 percent and ten crops with 10 percent. For this analysis, the standard deviation formula is used where'd' denotes the difference between the actual and theoretical percentage in a areal unit and 'n' denotes the number of crops.

Formula: $\sqrt{\sum d^2/n}$

According to Weaver crop combination method, Purba Medinipur district has five crop combination zone. For the analysis of crop combination, the percentage of all crops in the total cropped area has been calculated. The crops that actual coverage is below five percent are not included in this analysis because, they are insignificant compared to the dominated crop. The table (Table 4.6) shows the type of crop combination with associate crops and the number of villages in each type (Annexure 8). The given map represents the nature of crop combination in different villages of Purba Medinipur district (Fig. 4.8).

Single crop:

The single crop zone is observed in 99 villages of the district. Most of these villages are located on the Egra-I block. In this category, paddy is only the crop and cultivated twice

in a year. One is the Amon paddy in rainy season and other Boro paddy in summer season. However, in some places Aus paddy cultivation is also noticed.

Table 4.6 Types of crop combination with associate crops and the number of villages.

Combination Types	Crop Combination	Number of village
Single Crop	Paddy	99
Double Crop	Paddy/Vegetable/Jute/Pulses	866
Three Crop	Paddy/Vegetable/flower/Ground nut/Potato/Pulses/ Mustard	1308
Four Crop	Paddy/Vegetable/Flower/Pulses/Mustard	540
Five Crop	Paddy/Vegetable/Flower/Pulses/Jute/Potato/Mustard	186

Double crop combinations:

Double crop combinations denote the increases in the number of crops with diversification in crop combination. In this category, four types of crops produces in this area namely, paddy, vegetable, jute or pulses. The total 866 villages of the district are under this category. Double crop combinations are observed in most villages of Patashpur-I & II, Mahisadal, Bhagawanpur- I & II, Nandakumar, Egra-II, Chandipur and Sahid Matangini block.

Three crop combinations:

This category also denotes the increases in the number of crops with more diversification in combination. Three crop combinations includes the seven types crop production namely paddy, vegetable, flower, ground nut, potato, pulses or mustard. Three crop combinations are widespread in the district. Basically, it is largely observed along the coastal block like Ramnagar-I & II, Contai-I & III, Deshopran, Khejuri-II & II, Nandigram-I & II, Haldia and Sutahat and also in northern block of Panskura, Kolaghat Mayna and Tamluk. This category includes 1308 villages of the district.

Four crop combinations:

In four crop combination zone, the five types of crops produces, such as paddy, vegetable, flower, pulses or mustard. The total number of villages belong to this category are

540. Most of the villages of Panskura and Mayna block belong to this category. Besides, four crop combination zone are also found in some villages of Kolaghat, Nandigram-II, Khejuri-II, and Bhagawanpur-II.

Five crop combinations:

There are some villages like 186 of this district that have five crop combinations. Most of these villages are located in the Moyna and Kolaghat block. Seven types of crops are grown in five crop combination zone namely paddy, vegetable, flower, pulses, Jute, potato, or mustard.

4.2.3.3 Crop Diversification

Crop diversification is the opposite concept of crop specialization. The farmer, especially in the developing country tries to grow several crops in their holding in an agricultural year. So, crop diversification means growing of a variety of crops in a particular field instead only one crop. Crop diversification index is used for identifying the behaviour of crops over a time or period in a particular area (Jegankumar, 2017). Therefore, it helps significantly to the future planning and development of agriculture (Bisai et al., 2016). Crop diversification is driven by various reasons, such as,

1. One of the main reasons of crop diversification is the production of different food items for better nutrition.
2. It is helpful for taking advantage of changing market demands.
3. It is also increased farm's revenues and farmer's total income.
4. It helps the maximum use of different land (wetland, dry land, sloping land, forest land etc.)
5. Crop diversification enriches the soil with nutrients.
6. Even, if one crop is damaged in a hostile environment, the farmer has the opportunity to benefit from another crop.

In this study, Gibbs-Martin Index of Diversification (1962) has been adopted to identify the spatial patterns of crop diversification, where X denotes the percentage of total cropped area covered by each crop. According to the method, higher value represents higher diversification and higher diversification means larger numbers of crops are grown in an area.

$$\textbf{Index of Diversification} = 1 - \Sigma X^2 / (\Sigma X)^2$$

Crop diversification index has been calculated for each village of the district by using said formula and a map has been prepared according to the index value (Fig. 4.9). All the villages have been categorised into three classes such as high, medium and low (Table 4.7). The class division of crop diversification for high, medium and low is above 0.6, 0.3 to 0.6 and below 0.3 respectively. The classes of crop diversification has been determined by using mean and standard deviation of the data set and considered the round figure of the class value. Crop diversification is high in 1174 villages of Purba Medinipur district. Most of these villages are located in the Mayna, Panskura and Kolaghat block. In this category, large number of crops can be observed such as vegetable, paddy, Jute, flower, pulses, potato, and mustard. About half of the villages in this district are under medium crop diversification zone. The total village in this category is 1497 out of 2999 villages and it is mostly found in the block of Ramnagar-II, Sutahata, Egra-II, Contai-III, Chandipur, Desopran, Mahisadal, Patashpur-I, Khejuri-I and Nandigram-I & II. The low diversification is seen in 328 villages of the district. Most of these villages are located on the Egra-I, Patashpur-II and Bhagawanpur-I block (Annexure 9).

Table 4.7 Classes of crop diversification with number of village.

Class (Index value)	Number of village
Low (<0.3)	328
Medium (0.3 – 0.6)	1497
High (>0.6)	1174

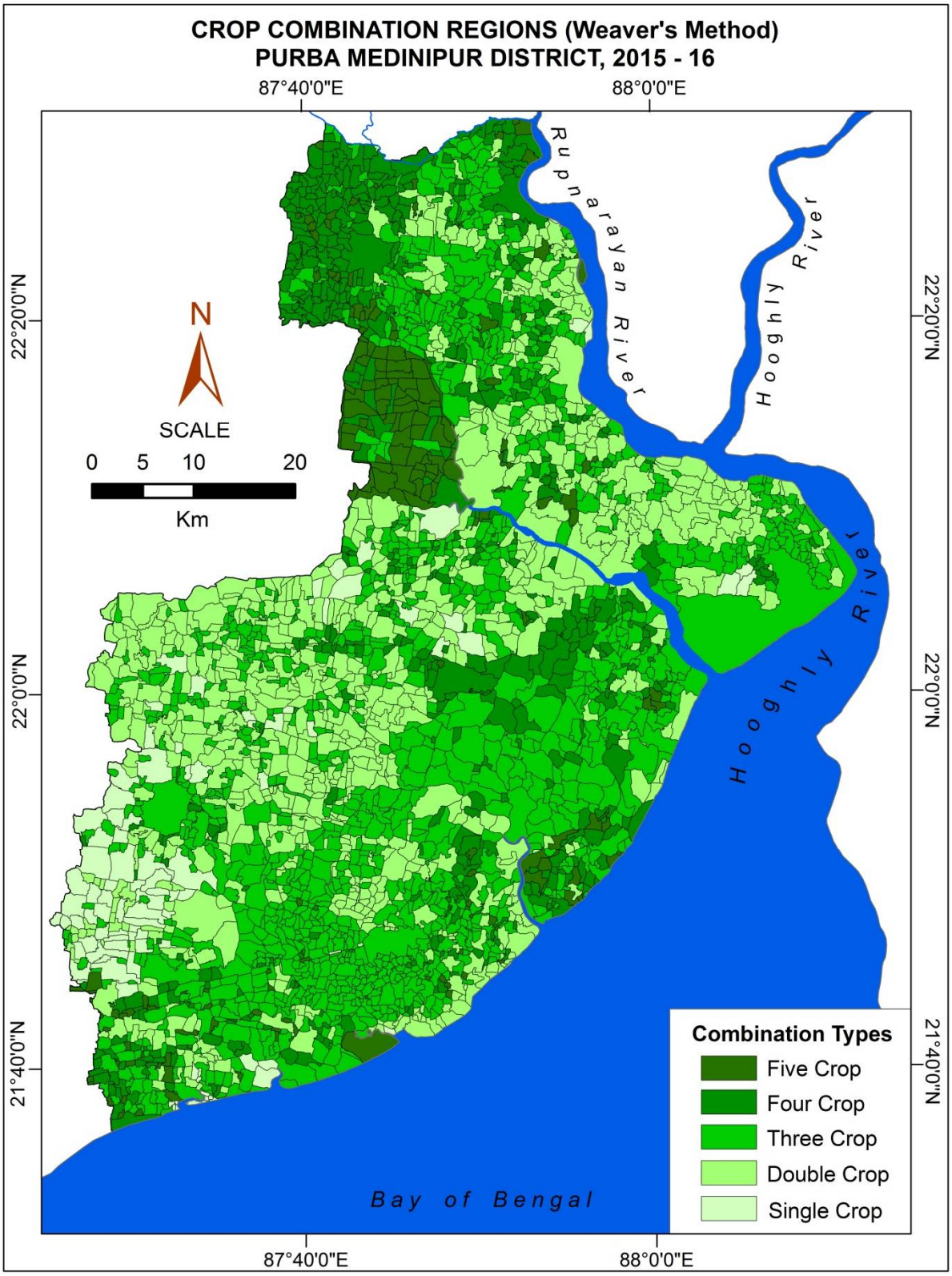

Fig. 4.8 Crop combination zone of Purba Medinipur district.

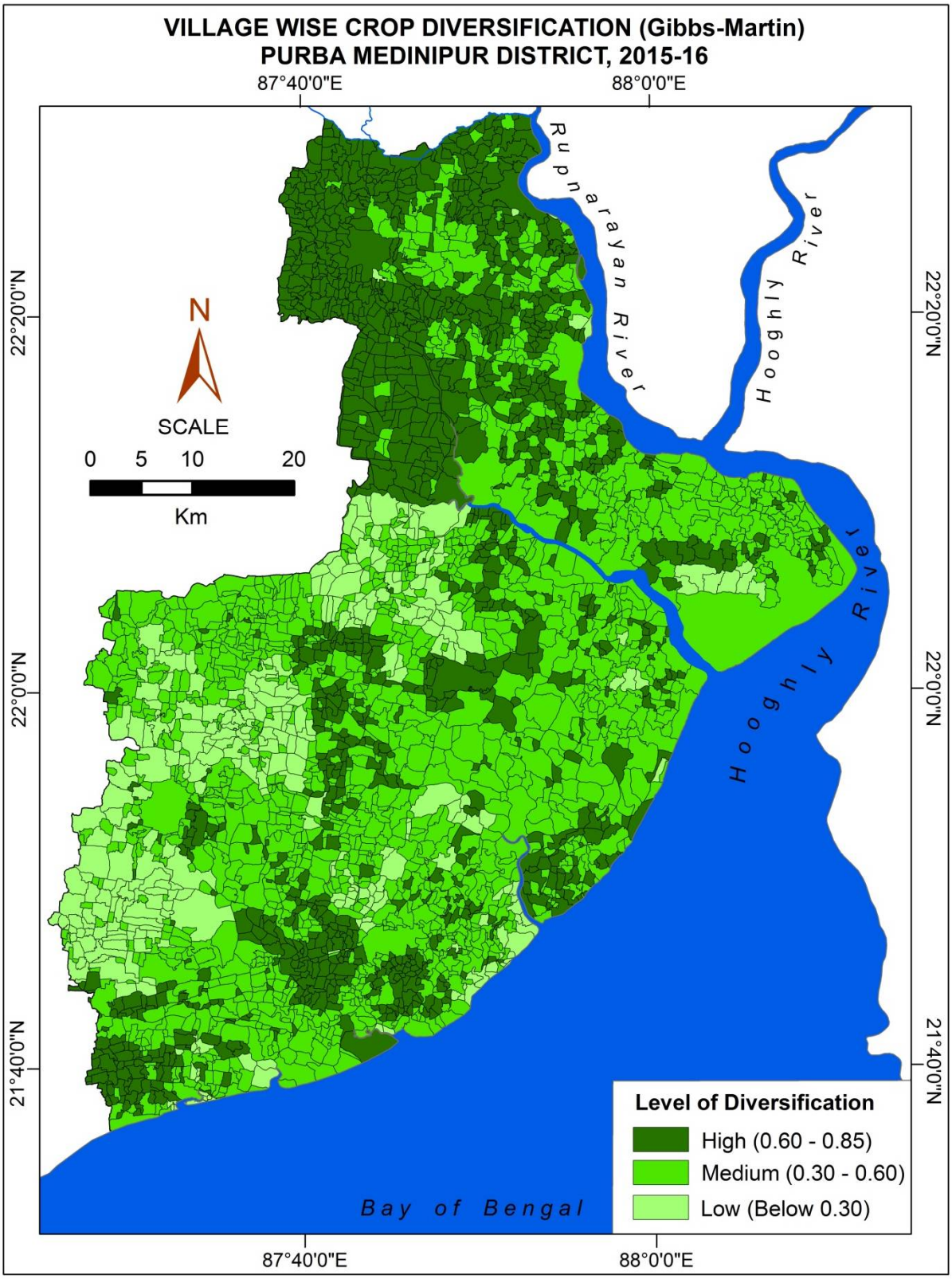

Fig. 4.9 Crop diversification zone of Purba Medinipur District.

4.3 Status of production and utilization of agricultural crops

Agriculture has an important role to improve the national economy of any country. Before industrialization, agriculture was the base of the economy of any country. At present, there are so many countries especially developing countries whose most part of economy depends on agriculture. People export surplus agricultural products after fulfilling their own demands which helps to make money by itself as well as to improve the national economy. Even the contribution of agriculture in any country is highest in terms of employment which also the secures of economy of the country. On the other hand, agriculture has an important role in industrial activities and service sector. Different agricultural products are used as a raw material in different industries, which are known as agro-industry. Different types of agro-industries are the food and beverage processing industry, paper, cotton, woolen, jute and silk textile etc. Thereafter, wholesale and retail market is required to sell industrial products. At the same time, there is a need for better transport, warehousing, banking and others infrastructural facilities. So, existence of these industries depends on the development and production of agriculture. Again, the development of agriculture depends on opportunities of farming, demand of agricultural products, benefits of the market, policies and protection of agriculture etc. Therefore, to make overall development of the economy and industry, the management and development of agriculture are necessary.

4.3.1 Present status of production of agricultural crops

The present study describes the current status of agricultural products and their utilization. The principal crops of the district are rice, jute, oil seeds, pulses and potato. The most important food crop of the district is rice. There are three types of rice cultivation followed, such as aus, amon and boro. According to the agricultural report of 2013-14 published in District Statistical Handbook, the yield rate of boro paddy is 3408 kilogram per

hectare. Total production of boro paddy in this year (2013-14) is 476.9 thousand tonne. The rate of yield of amon and aus paddy is 1585 and 2034 kilogram per hectare and total production is 376.1 and 23.3 thousand tonne respectively. The yield rate of potato is also high in the district which is 29972 kilogram per hectare and total production is 112.4 thousand tonne. Oilseeds are produced at the rate of 2172 kilogram per hectare and total amount of production is 39.2 thousand tonne. The yield rate of pulses is 1437 kilogram per hectare and total amount of production is 11.9 thousand tonne. The yield rate of jute per hector is 13.54 kilogram and total amount of production is 5.0 thousand tonne in the year of 2013-14. The yield rate of different crops is shown in table 4.8. The table (Table 4.9) and diagram (Fig. 4.10) shows the different principal crops and their production. Here different types of vegetable are cultivated, like tomato, cabbage, cauliflower, brinjal, onion, radish, ladies finger, cucurbits etc. The most important vegetable of the district is brinjal then cucurbits which production is 164.72 and 123.31 thousand tonne in the year of 2013-14. The table (Table 4.10) and diagram (Fig. 4.11) shows the different types of vegetables and their production of the district. Flower cultivation also helps the local people in their economic development. Maximum flower is exported out of the district as well as to other state of the country. Major cultivated flower is rose, tuberose, marigold, chrysanthemum, gladiolus etc. The table (Table 4.11 & 4.12) and diagram (Fig. 4.12 & 4.13) shows the different flower and their production of the district.

Table 4.8 Different types of crop and their yield rates, 2013-14.

Crops	**Yield rates (Kilogram per hectare)**
Aus	2034
Amon	1585
Boro	3408
Total Pulses	1437
Oil seeds	2172
Jute	13.54
Potato	29972
Source: District Statistical Handbook, Purba Medinipur, 2013-14	

Table 4.9 Production amount of different types of crops in 2013-14

Crops	Production (Thousand tonne)
Aus	23.3
Aman	376.1
Boro	476.9
Potato	112.4
Jute	5.0
Total Oil seeds	39.2
Total Pulses	11.9
Source: District Statistical Handbook, 2013-14	

Table 4.10 Production amount of different types of vegetables in 2013-14

Name of Vegetables	Amount of production (Thousand tonne
Tomato	20.01
Cabbage	33.00
Cauliflower	32.50
Brinjal	164.72
Onion	7.82
Cucurbits	123.31
Ladies Finger	50.26
Radish	14.76
Others	77.95
Source: District Statistical Handbook, 2013-14	

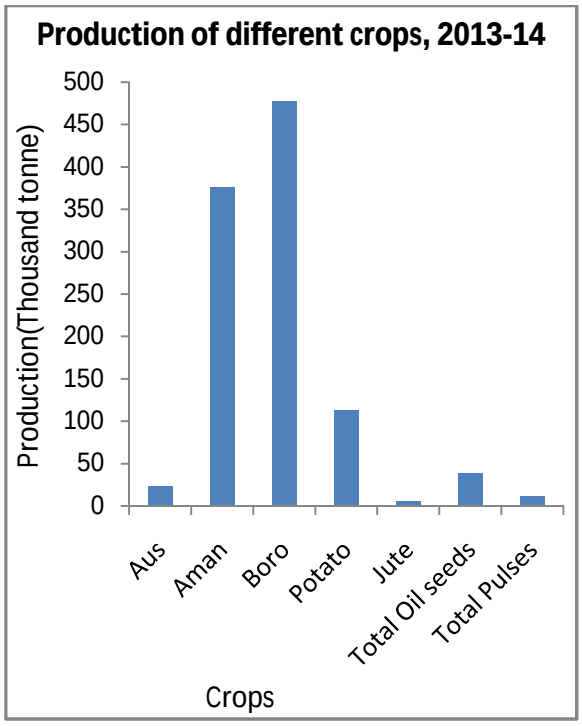

Fig. 4.10 Production amount of different crops of Purba Medinipur district.

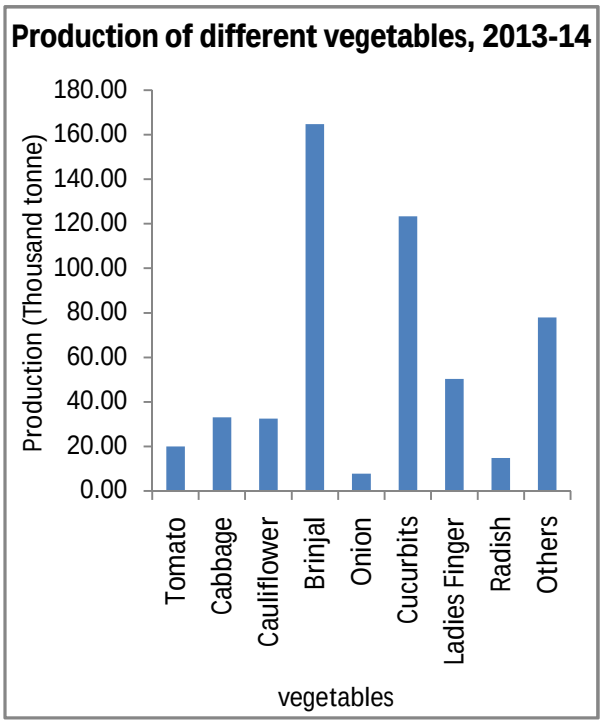

Fig. 4.11 Production amount of different vegetables of Purba Medinipur district.

Table 4.11 Production amount of flowers in 2013-14

Name of Flowers	Production (Crore cut flower)
Rose	34.590
Chrysanthemum	6.435
Gladiolus	6.100
Tuberose	17.110
Source: District Statistical Handbook, 2013-14	

Table 4.12 Production amount of flowers in 2013-14

Name of Flowers	Production ('000 mt)
Marigold	12.000
Jasmine	0.396
Seasonal Flower	2.063
Misc.Flower	0.556
Source: District Statistical Handbook, 2013-14	

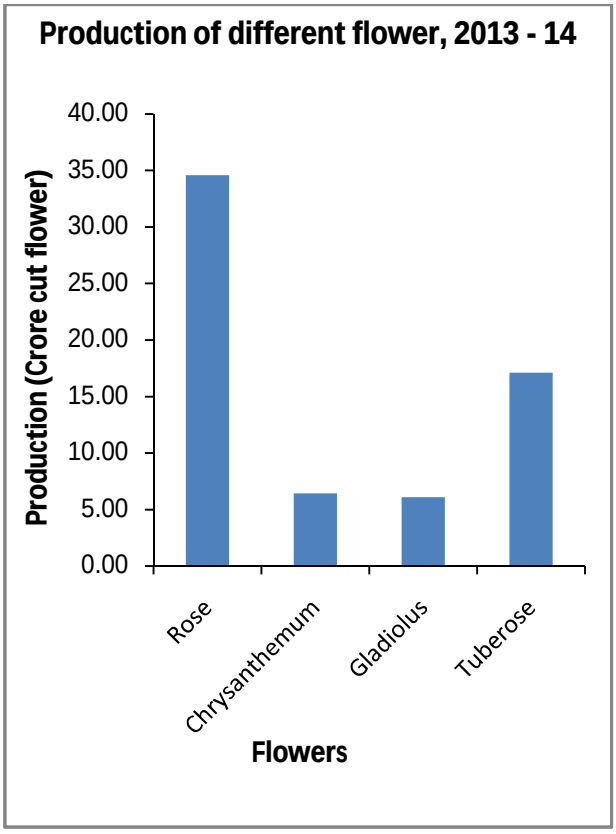

Fig. 4.12 Production amount of different flower of Purba Medinipur district.

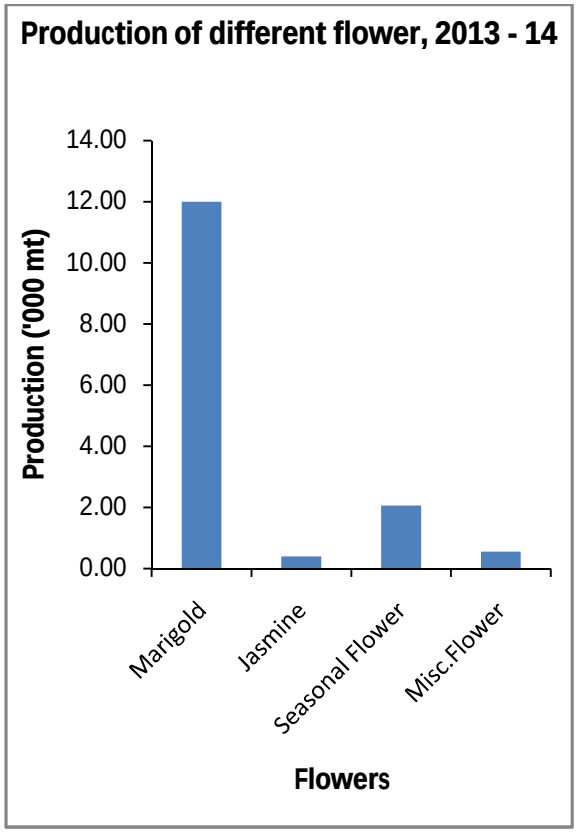

Fig. 4.13 Production amount of different flower of Purba Medinipur district.

4.3.2 Growth rate of agricultural crop production

The table (Table 4.13) and diagram (Fig. 4.14 & 4.15) shows the amount of different crop production such as rice, potato, jute, oil seeds, and pulses from 2003-04 to 2013-14 of the district. From the diagram, it is found that the amount of production of each crop except potato is almost the same in every year. Only the production of potato has increased a lot from before. Paddy is the most productive crop in each year. The table (Table 4.14) and diagram (Fig.4.16) also depict the yearly production of different types of vegetable such as tomato, cabbage, cauliflower, brinjal, onion, cucurbits, ladies finger, radish etc. It is also observed that the production of brinjal, and cucurbits has increased at higher rate and ladies finger, cabbage, cauliflower has increased slightly than before. But, the production of others vegetable is almost the same in every year.

Table 4.13 Yearly productions of different crops of Purba Medinipur district (Thousand tonnes)

Crops	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Rice	1008.4	1065.4	786.7	1045.3	821.8	879.9	1038.1	1228.8	1010.2	1060.3	876.3
Potato	48.5	56.7	56.9	49.6	76.2	73.8	129.1	129.6	111.7	108.8	112.4
Jute	31.2	11.7	21.0	26.5	8.4	7.5	6.9	11.7	9.7	7.6	5.0
Total Oil seeds	31.3	27.2	31.6	36.7	40	29.1	30.2	30.4	78.8	39.2	39.2
Total Pulses	8.4	11.3	11.2	13.0	8.5	0.8	0.9	9.2	9.4	11.8	11.9
Source: District Statistical Handbook, Purba Medinipur											

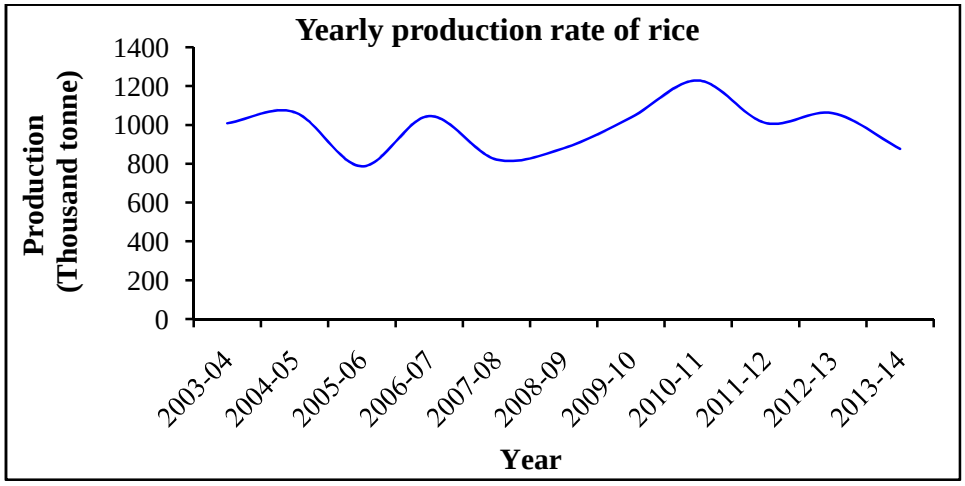

Fig. 4.14 Production of rice of Purba Medinipur district.

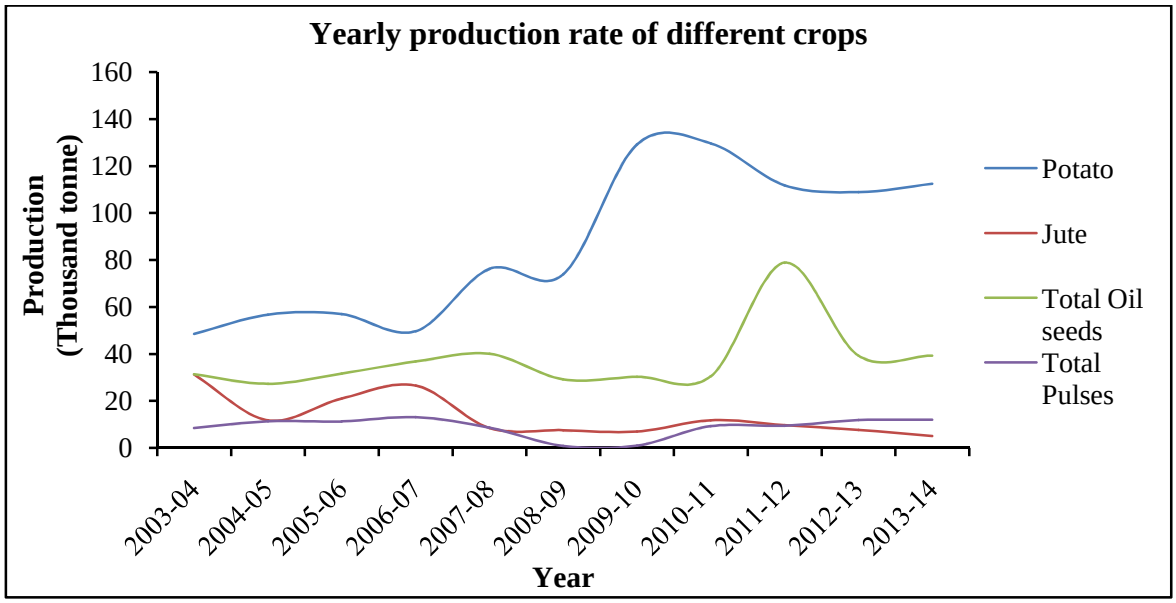

Fig. 4.15 Production of different crops of Purba Medinipur district.

Table 4.14 Yearly productions of different vegetables of Purba Medinipur district (Thousand tonnes)

Name of Vegetables	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Tomato	1.20	1.20	1.30	13.87	11.33	11.27	17.27	17.50	19.50	19.61	20.01
Cabbage	1.60	1.70	1.75	38.33	28.09	28.19	28.20	28.59	30.59	31.89	33.00
Cauliflowe	1.80	1.90	1.60	28.85	23.29	17.35	27.36	27.72	29.36	32.46	32.50
Brinjal	9.10	10.10	9.32	94.31	129.1	144.6	148.6	117.6	157.5	158.6	164.7
Onion	0.70	0.70	0.81	5.77	5.99	6.25	7.25	7.45	7.71	7.81	7.82
Cucurbits	10.2	10.40	12.61	102.81	107.6	112.4	117.4	121.7	123.0	122.6	123.3
Ladies	4.10	4.20	4.29	43.37	45.71	43.82	47.82	49.06	49.11	48.24	50.26
Radish	1.00	1.00	1.07	10.55	12.03	12.03	12.63	3.16	13.22	14.41	14.76
Others	16.9	18.40	18.12	101.52	91.06	69.78	70.77	117.5	78.71	77.95	77.95
Source: District Statistical Handbook, Purba Medinipur											

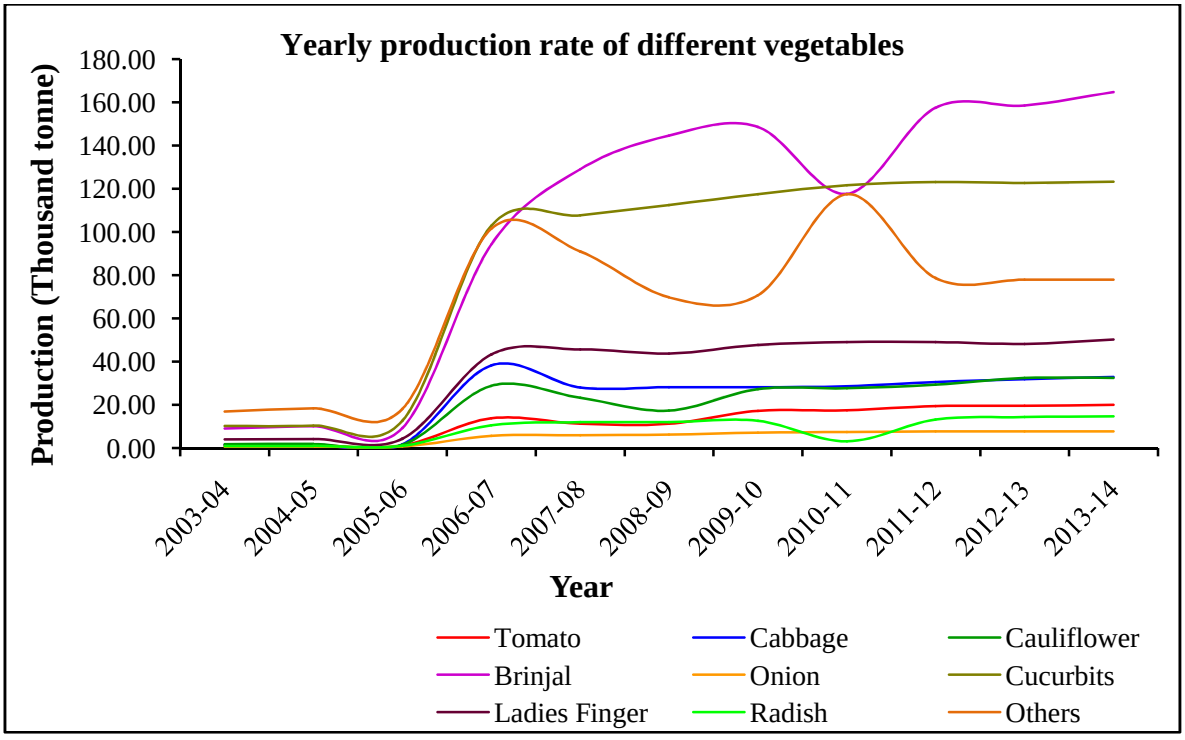

Fig. 4.16 Production of different vegetables of Purba Medinipur district.

4.3.3 Growth rate of flower production

The table (Table 4.15) shows the amount of production of different flower from 2003-04 to 2013-14 agricultural year such as rose, chrysanthemum, gladiolus, tuberose, marigold, jasmine, seasonal flower etc. The diagram (Fig.4.17a and 4.17b) depict the production of

rose, marigold and tuberose which are increased at higher rate but the amount of production of others flower is almost the same in each agricultural year.

Table 4.15 Yearly production of different flowers of Purba Medinipur district.

Name of Flowers	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Rose(Crore Cut Flower)	0.50	0.52	0.58	9.49	31.75	33.18	33.46	34.23	34.53	34.55	34.59
Chrysanthemum (Crore Cut Flower)	0.10	0.12	0.15	4.020	4.88	5.26	5.66	5.72	6.43	6.43	6.44
Gladiolus (Crore Cut Flower)	0.20	0.22	0.29	3.32	4.14	4.40	4.70	5.28	6.00	6.08	6.10
Tuberose (Crore Cut Flower)	0.75	0.77	0.48	12.80	13.31	13.87	15.94	17.43	17.88	16.94	17.11
Marigold ('000 mt)	1.11	1.17	1.10	10.00	10.14	10.65	11.15	11.40	11.90	11.93	12.00
Jasmine ('000 mt)	0.28	0.28	0.29	0.37	0.37	0.38	0.38	0.38	0.39	0.39	0.40
Seasonal Flower ('000 mt)	1.30	1.62	1.23	1.70	1.65	1.77	1.97	1.98	2.04	2.06	2.06
Misc.Flower ('000 mt)	0.50	0.51	0.48	0.43	0.63	0.55	0.55	0.55	0.55	0.55	0.56
Source: District Statistical Handbook, Purba Medinipur											

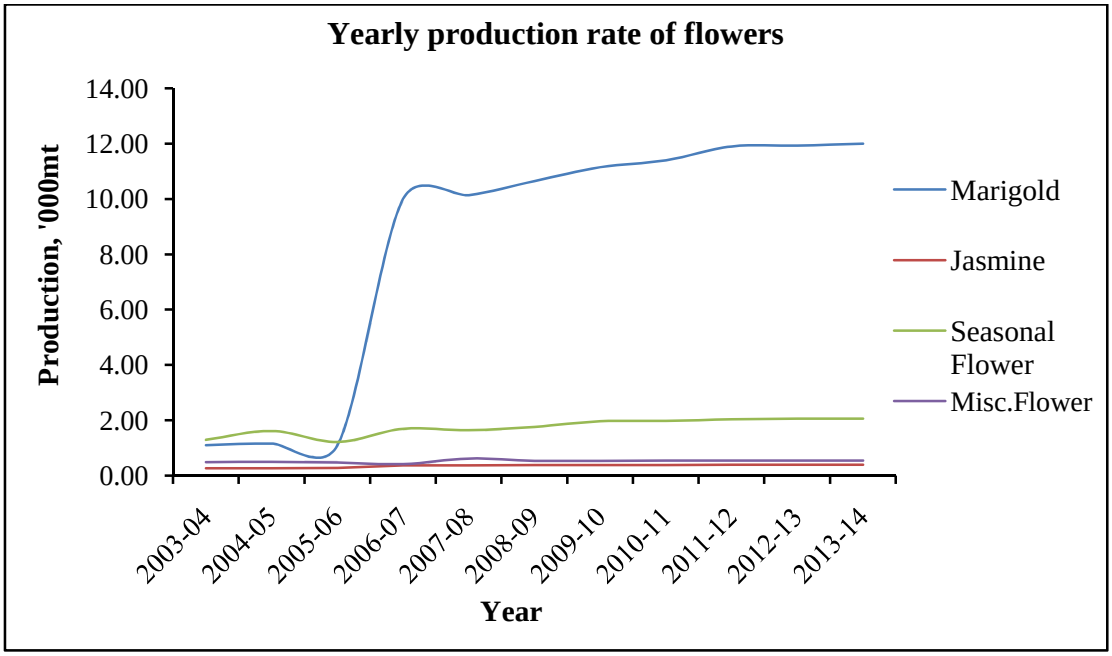

Fig. 4.17a Production of different flowers of Purba Medinipur district.

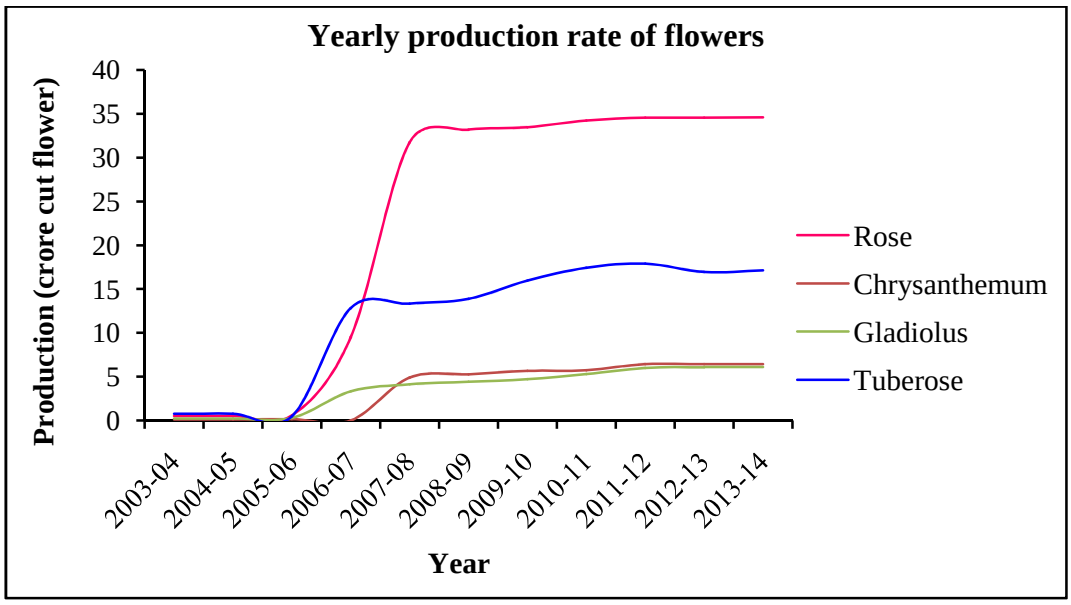

Fig. 4.17b Production of different flowers of Purba Medinipur district.

4.3.4 Utilization status of agricultural crops

In Purba Medinipur district, different agro-industries have developed depends on the local agricultural products. The major agro-based industry of the district is the food and beverage processing industry as well as some other industries. The nature of these industries is small and micro scale in size. The table (Table 4.16) shows the different types and number of agro-industries of Purba Medinipur district. There are 153 rice milling, flour milling, rice husk and rice broken industry throughout the district (Fig. 4.18). The number of spices grinding and oil expelling industries are 25 and 10 respectively. Other agro-industries such as jute products, fried dal, bio fertilizer, fish meal and fish food, veg-pickles, jam, jelly, papad, bread, biscuit and cake etc. are also found in the district (Fig. 4.19).

There are 321 agro-markets in the district which are different in scale size. Agricultural market is a place where agricultural products are bought and sold. It is a place where agricultural products are delivered to the consumer from the farm. Most of the markets of the district have developed based on the local agricultural products. Farmer collects their crops and sells them in the local market. There are three types of market such as daily, bi-weekly,

tri-weekly and weekly. The number of daily, bi-weekly, tri-weekly and weekly markets are 69, 14, 216 and 22 respectively (Table 4.17). The map (Fig. 4.20) shows the spatial distribution of agro-markets of the district.

Table 4.16 Different agro-based industries with number of unit.

Name of Agro-based Industry	Number of Unit
Rice Milling, Flour Milling, Rice husk, Rice Broken	153
Spices grinding	25
Oil expelling	10
Jute products	4
Fried dal	2
Bio fertilizer	4
Fish meal and fish feed	3
Veg pickles, Jam, Jelly	1
Jam, Jelly and juice	1
Papad	1
Bread, Biscuit, Cake	9
Total	213
Source: District Industrial Profile, Ministry of MSMEs, Government of India, 2016	

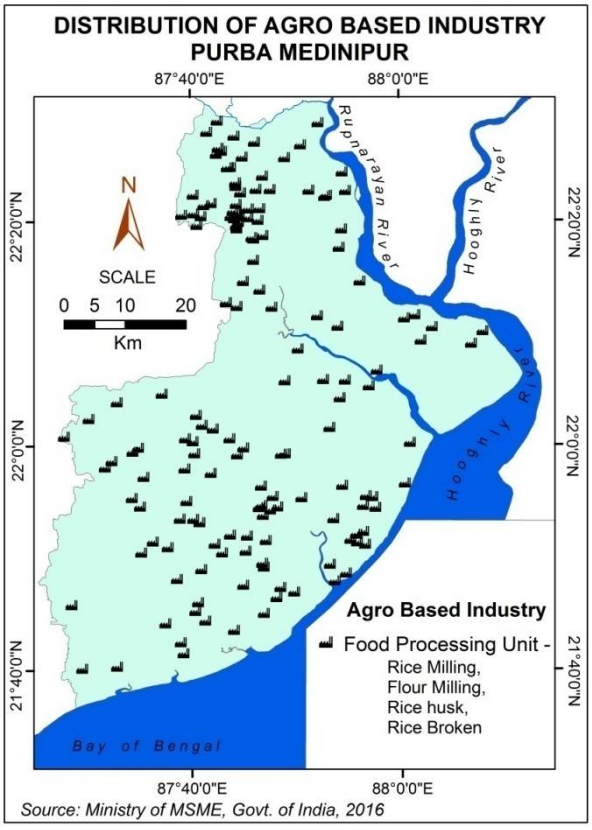

Fig. 4.18 Distribution of different food processing unit of Purba Medinipur district.

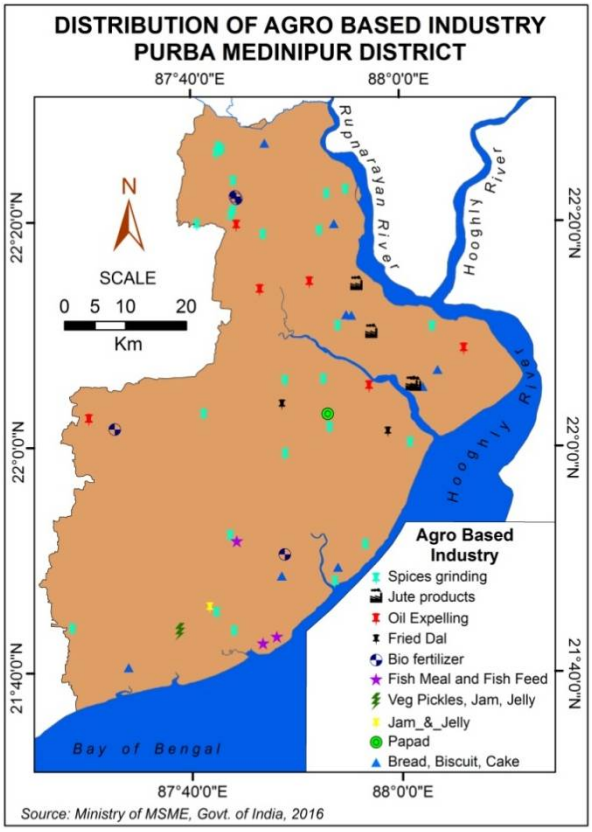

Fig. 4.19 Distribution of different other agro-industries of Purba Medinipur district.

Table 4.17 Nature of market with number.

Market frequency	Number
Daily	69
Tri-weekly	14
Bi-weekly	216
Weekly	22
Total	321
Source: Market Directory of Purba Medinipur district, Market Survey Report 2011-12	

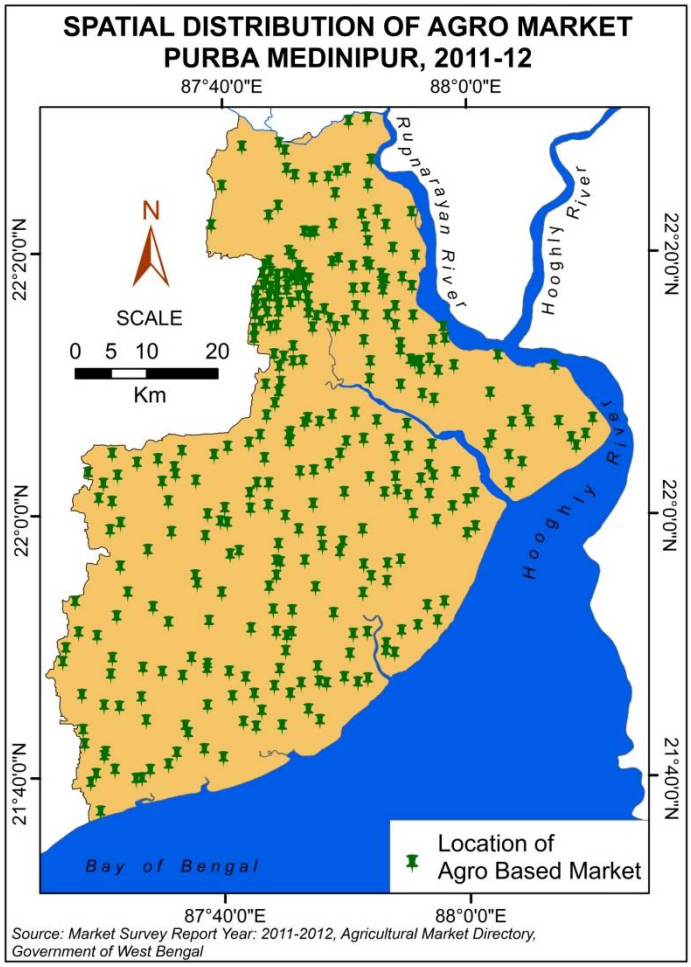

Fig. 4.20 Spatial distribution of agro-market of Purba Medinipur district.

4.4 Status of production and utilization of forest resources

Here, the forest is grown which is planted by farmer and government or semi-government organisation called social or agro-forestry. This forestry is basically indicates as the horticulture of the district. Farmers mainly give more importance to fruit production in the case of agro-forestry than wood growing trees. Therefore, farmers are able to earn more money from this production. Different types of fruit growing trees are planted in various places of the district, such as mango, banana, pineapple, papaya, guava, jackfruit, litchi, sapota etc. The table (Table 4.18) and diagram (Fig. 4.21) shows the different types of cultivated fruits and their production in the district during the agricultural year 2013-14. On the basis of fruit cultivation, different food and beverage processing industry has formed in

the district (Fig. 4.19). On the other hand, the forest created by government is mainly for wood and fuel. The amount of production of timber and fuel is 0.416 and 1.466 thousand cubic metres during the agricultural year 2013-14 (Table 4.19). The diagram shows the production amount of timber and fuel (Fig. 4.22). The table (Table 4.20) and diagram (Fig. 4.23) shows the amount of production of different fruits from 2003-04 to 2013-14 agricultural years such as mango, banana, pineapple, papaya, guava, jackfruit, litchi, sapota, citrus etc. Here, production of banana is highest among all the fruits. The rate of production of every fruit is almost same in each year.

Table 4.18 Production amount of different fruits in 2013-14.

Name of Fruits	**Production (Thousand tonne)**
Mango	6.75
Banana	52.00
Pineapple	3.40
Papaya	17.00
Guava	9.40
Jackfruit	5.00
Litchi	0.32
Other Citrus	8.40
Sapota	9.59
Others	8.34
Source: District Statistical Handbook, 2013-14	

Table 4.19 Production amount of forest resources in 2013-14

Item	**Production** (Thousand cu.metre)
Timber	0.416
Fuel	1.466
Source: District Statistical Handbook, 2013-14	

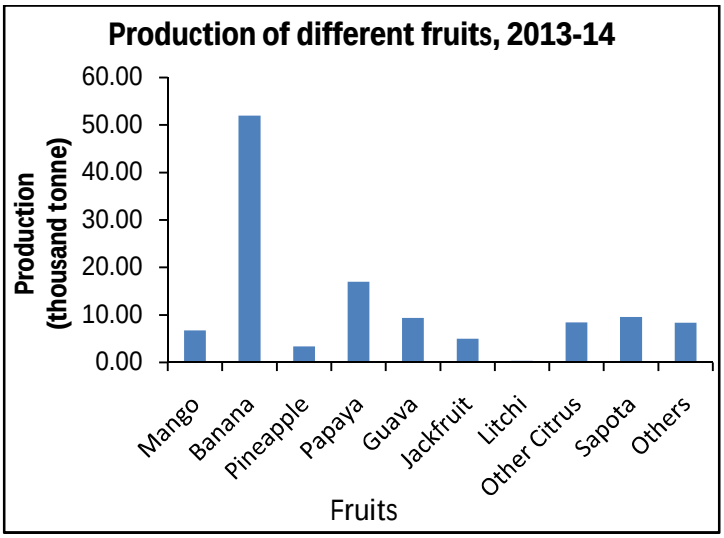

Fig. 4.21 Production amount of different fruits of Purba Medinipur district.

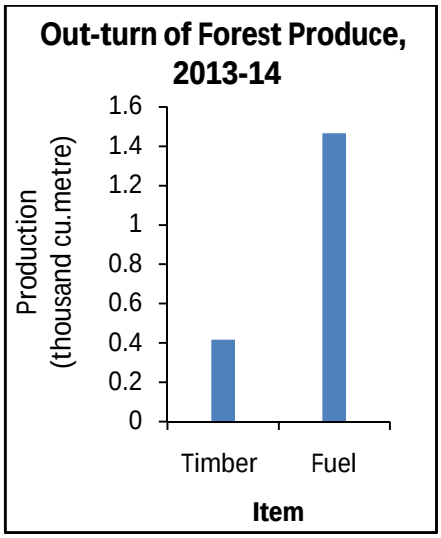

Fig. 4.22 Production amount forest produce of Purba Medinipur district.

Table 4.20 Yearly amount production of different fruits of Purba Medinipur district (Thousand tonnes).

Name of Fruits	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Mango	17.40	20.40	17.22	17.35	17.66	17.70	17.70	17.90	18.51	18.85	6.75
Banana	57.40	58.50	57.04	47.50	51.89	52.02	52.02	52.52	52.99	53.10	52.00
Pineapple	8.40	9.00	7.56	4.51	4.98	4.13	4.13	4.13	4.05	3.90	3.40
Papaya	14.60	15.10	15.47	15.25	16.82	16.92	16.92	17.04	17.18	17.21	17.00
Guava	9.20	9.30	11.39	8.94	9.42	9.92	9.98	9.98	9.98	10.10	9.40
Jackfruit	7.00	7.20	7.41	7.65	5.36	5.29	5.29	5.29	5.30	4.90	5.00
Litchi	0.80	0.90	0.95	0.99	0.88	0.18	0.29	0.29	0.29	0.31	0.32
Other Citrus	8.80	8.90	9.36	9.65	9.04	8.15	8.15	8.15	8.35	8.38	8.40
Sapota	9.20	9.30	10.03	11.63	9.95	9.15	9.45	9.55	9.55	9.58	9.59
Others	4.60	5.70	6.04	6.10	7.12	9.11	9.12	9.22	8.54	8.30	8.34
Source: District Statistical Handbook, Purba Medinipur											

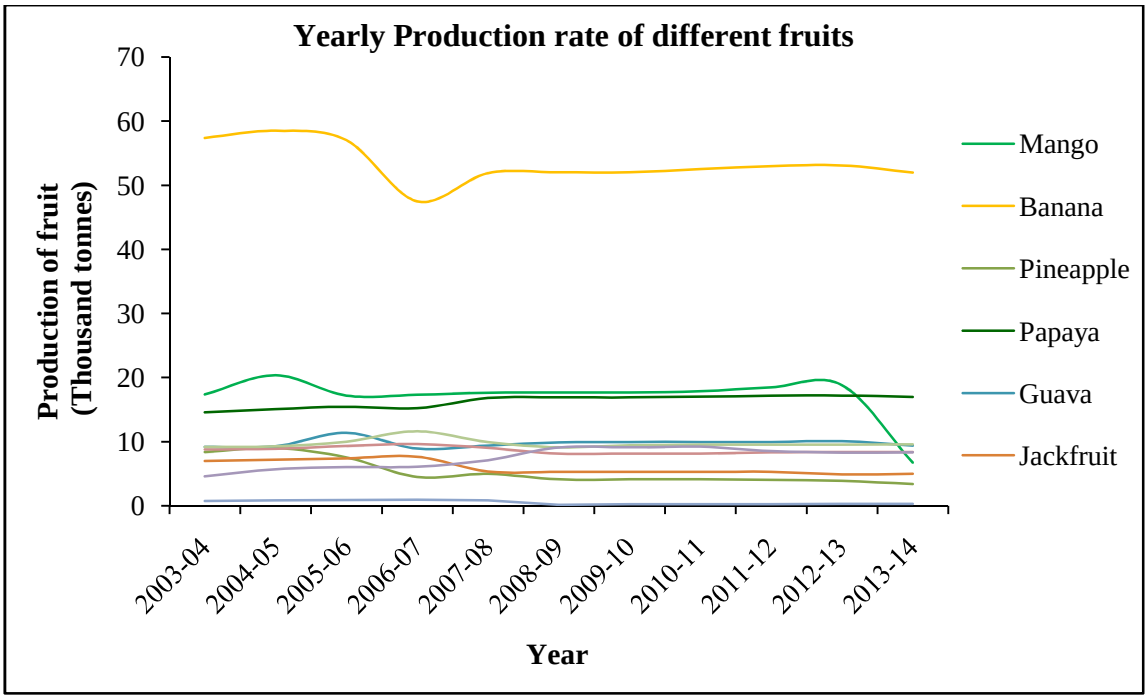

Fig. 4. 23 Production of different fruits of Purba Medinipur district, 2003 – 2014.

4.5 Fisheries: Assessment in terms of environment

As defined by Food and Agriculture Organisation (FAO, 1998), the fishery is “A unit determined by an authority or other entity that is engaged in raising and/or harvesting fish”. In rural areas of the district, fishing is the most important economic activity. It is an

imperative part in the socioeconomic expansion, accomplishing the demand of food protein, prospect for employment, poverty mitigation and making foreign exchange (DoF, 2006). In Purba Medinipur district, inland fisheries are increased rapidly on a commercial basis. It is noticeable that day to day pond fishery is going off and the commercial fishery is developed (Karan et al. 2019). To build the commercial fisheries, a vast agricultural land as well as forest land is being acquired. As a result, day to day agricultural land and forest land is converted into fishing ground. Now, the study describes how the agricultural land is being converted into the fishery in Purba Medinipur district.

Four years LANDSAT-8 satellite data has been used to show the conversion of agricultural land into the fishery. The change of agricultural land is shown at one year interval from 2013 to 2019 based on the images of April 2013, March 2015, April 2017 and May 2019. All the images were acquired by Lansat-8 OLI sensor which spatial resolution of four bands (Blue, Green, Red and Near Infrared) are 30 metres. NDWI method has been used to extract the water body from each image. The estimated value of NDWI and the considered value for water body delimitation in each year are shown in the table 4.21 and the table 4.22 shows the amount of fishery land of different years. The considered values for water bodies have been determined according to ground verification and resemblance with Google Earth image where it is noticed that the pixels within this range is matched with water bodies. The map revealed the change of agricultural land into fishery where a large amount of land is converted into fishery in a short duration (Fig. 4.24). The diagram (Fig. 4.25) shows the growth rate of fishery from 2013 to 2019 where the fishery was 17107.2 hectares in 2013, it increased to 35832.69 hectares in 2019. There are some reasons for the high growth of fishery and these are follows:

i. The main reason is that the farmers earn maximum profit from his land through fishery than crop cultivation. They (land owners) earn Rs. 30000 to 50000 per ‘bigha’ land (1

bigha = 0.16055846 hectares) as a land rent for the fishery per year. It is depends on location of the land and others factors.

ii. There is no large scale agro-based industry in the district. So, local farmers have the opportunity to work in this farming system after their own agricultural activities.

iii. The maximum land lease is taken for average 3 to 10 years, and then it is renewed again. Thereby, the land ownership of the farmers is protected.

iv. Apart from the availability of tidal water, dense drainage system also helped to develop the fishery of the district.

Purba Medinipur has two types of fishing ground, one is the inland and other is marine. The table (Table 4.23) shows the yearly production of inland and marine fish of the district. It is noticeable that day to day inland fish production is higher than the marine fish and also marine fish production is decreasing (Fig. 4.26). As per Fishery Statistical Handbook 2015-16, the amount of inland fish production in 2011-12 is 46.87 percent and marine fish production 53.13 percent out of the total, but in 2015-16, inland fish production is 75.63 percent where marine fish production is 24.73 percent. The reason is that inland fish production is increasing due to the increasing of inland fishing ground, but there are different restrictions have imposed on collecting marine fishes.

Table 4.21 Estimation of fishing ground in Purba Medinipur district using NDWI technique.

Year	**Estimated NDWI Value**	**Consider the range of NDWI value of water bodies**
2013	-0.5 – 0.18	-0.1 – 0.18
2015	-0.46 – 0.19	-0.1 – 0.19
2017	-0.5 – 0.19	-0.12 – 0.19
2019	-0.49 – 0.14	-0.12 – 0.14

Table 4.22 Area of inland fishery of Purba Medinipur district in different years.

Year	**2013**	**2015**	**2017**	**2019**
Area of Inland Fishery (Hectare)	17107.2	20339.1	28361.97	35832.69

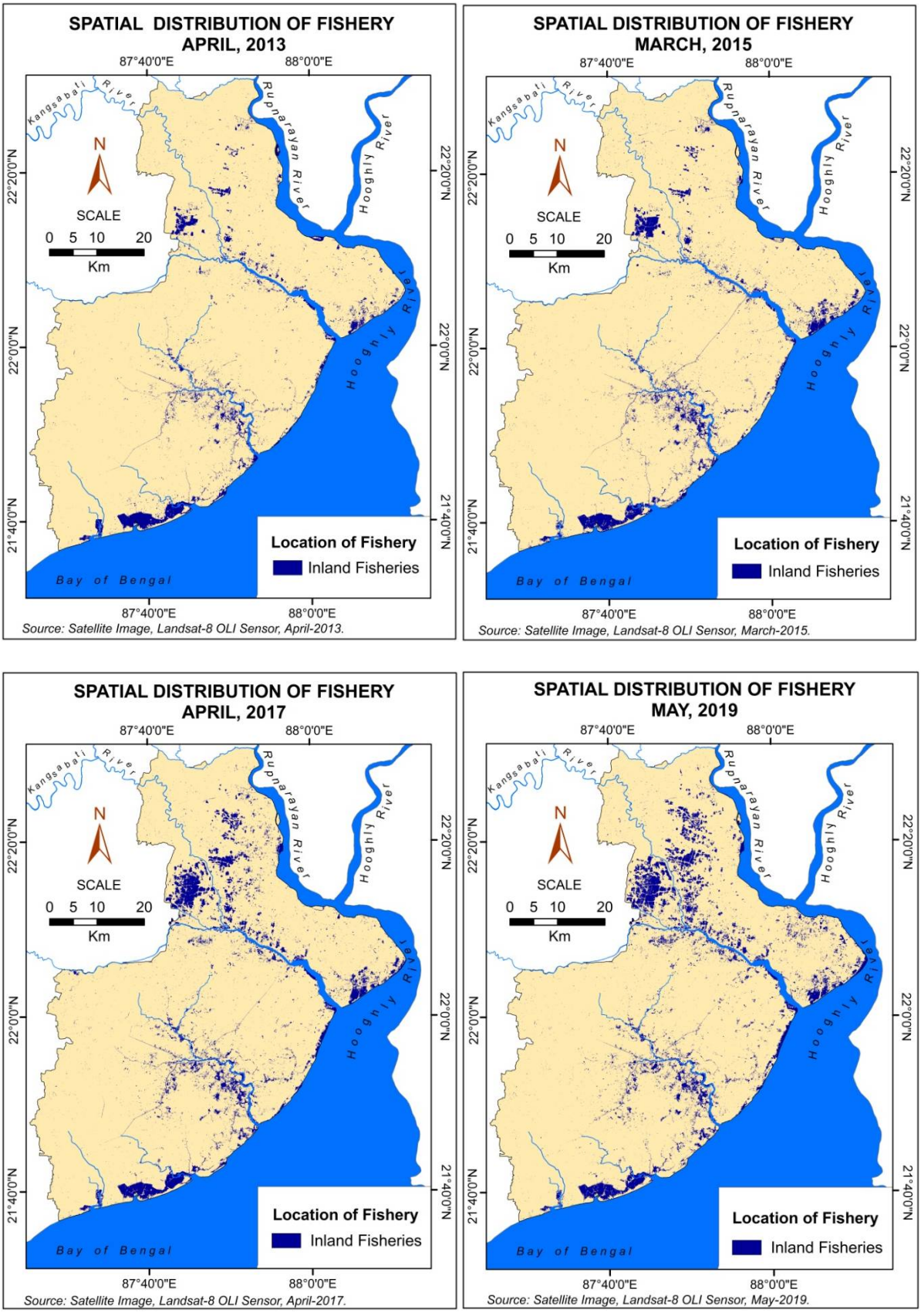

Fig. 4.24 Growth of fishing ground of Purba Medinipur district from 2013 to 2019.

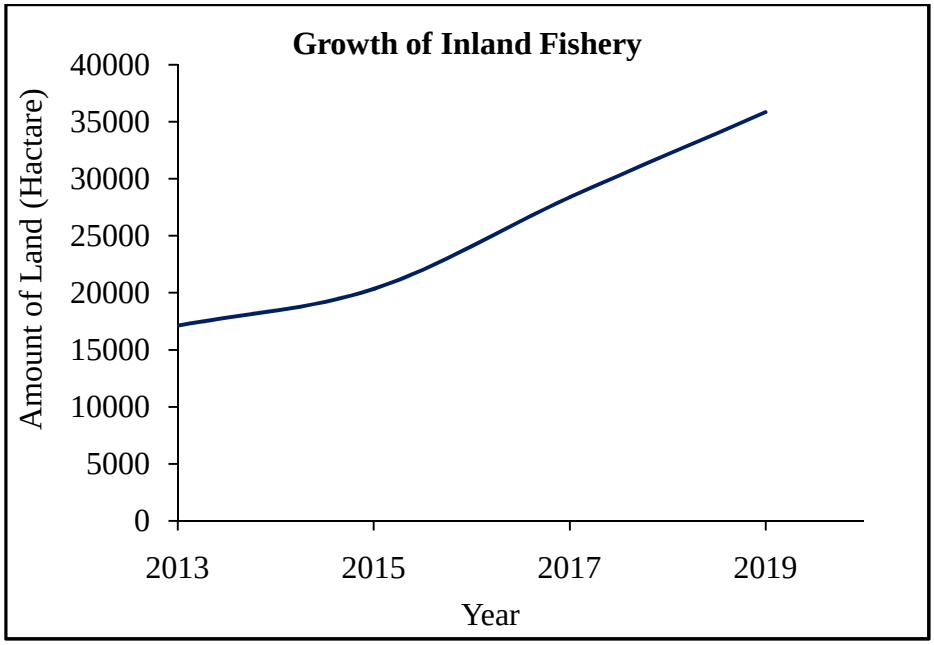

Fig. 4.25 Growth rate of inland fishing ground from 2013 to 2019.

Table 4.23 Inland and marine fish production of Purba Medinipur district in different years.

Type of fish	Fish Production (tonnes)				
	2011-12	**2012-13**	**2013-14**	**2014-15**	**2015-16**
Inland fish	113816	141745	148338	159299	164731
Marine fish	129011	105503	56595	52176	53089
Total	242827	247248	204933	211475	217820
Source: Fishery Statistical Handbook, 2015-16					

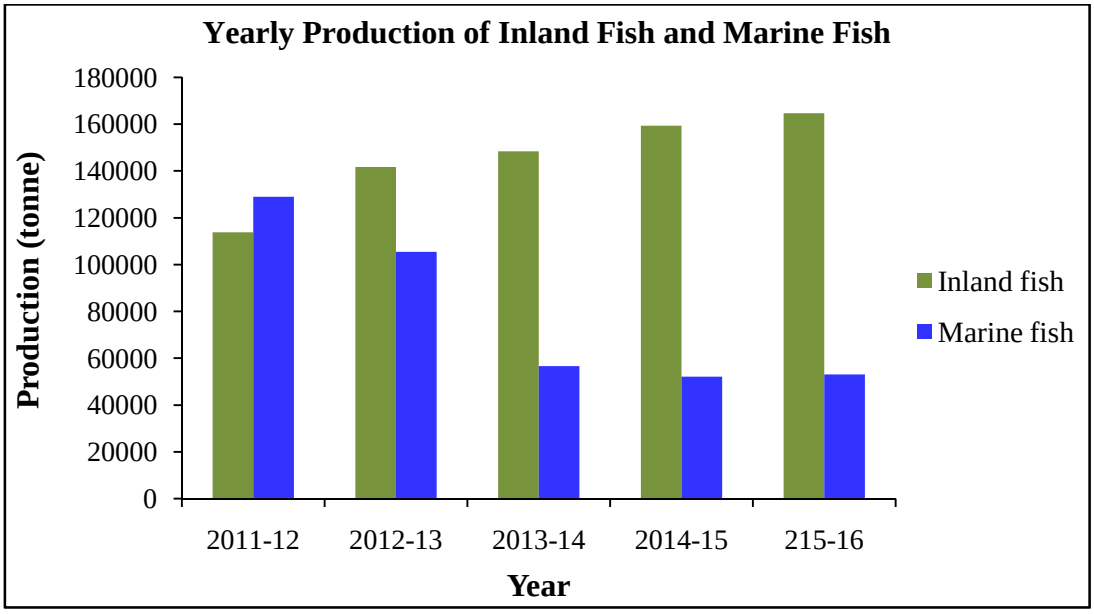

Fig. 4.26 Comparison of inland and marine fish production.

The fishery is a fast-growing industry in the world due to the significant increase in the demand for fish worldwide (Gang et al. 2005). At present, it is the most profitable economic activities than other animal farming (Karan et al. 2019). Therefore, it is growing more rapidly than other animal farming industry. In order to meet these additional needs and earning more money, fisheries are damaging the environment both directly and indirectly. The main reasons are the inappropriate management method and unscientific fish farming. Some aspects of environmental damage are explained below on the basis of primary survey in the district.

i. Due to the acquiring of large amount agricultural land, the agricultural production is being disrupted.

ii. The large number of trees is being destroyed for the acquiring of forest land.

iii. The clearing of forests is causing destruction of habitat and related ecosystem.

iv. Due to the construction of the fishery here and there, the natural drainage is hampered especially in the rainy season. As a result, water logging problem is found and sometimes flood also occurs during excessive rainfall.

v. Soil erosion is increased due to the growth of fishing ground. Because the dam of the fishery is not covered with vegetation and as a result the soil is eroded during rainy season and wash out by the river or canal. It is the continuous process in every season.

vi. The waste material from the fishery is mainly solid, chemicals and therapeutics which are harmful and poisonous to the local environment.

vii. For the management of fisheries different agrochemicals, antibiotics and disinfectants are used which remains in the water after the aquaculture products (Islam and Yasmin, 2017). When this wastewater is discharged into surrounding agricultural fields, river or canal, it creates ecological problems like eutrophication or algae bloom and related environmental problems (Karan et al. 2019).

The impact of the fishery on environment is usually due to the release of waste water and waste materials in the surrounding places without any treatment. Deforestation, excessive use of chemicals, wastewater pollution are hampering the environmental balance. So, it needs to be controlled with proper management. Some methods can be mentioned to control this problem such as:

i. Fishery cannot be built by destroying forests and multi crop lands also should not be used for fish farming.
ii. Fishery should be built on fallow land or it can be considered in the agricultural lands where crop cultivation is less, such as single crop lands.
iii. Different trees need to be planted along the dams of the fishery which will prevent the soil erosion and will not harm the fish farming.
iv. Appropriate methods should be implemented to control the pollution caused by aquaculture wastewater, such as wastewater needs to be discharged after proper treatment.
v. The use of agrochemicals, antibiotics and disinfectants for the farm management should be in specific dimensions.
vi. Waste materials released from fish and fisheries should be properly managed.
vii. Proper drainage system should be maintained around the fishery.

This chapter has thoroughly described the status of agro-natural resources production and utilization of the district. It is very important to know the nature of agricultural landuses for agricultural management. So, the chapter has depicted the amount of cultivated land and its seasonal uses of the district. The chapter has also analysed the characteristics of cropping intensity, types of crop combination and level of crop diversification which depict the

cropping pattern and its nature of the study area. The cropping pattern indicates the nature of agricultural development of a region. The present situation of agro-natural product and its uses and also growth rate over a past few years has explained in this chapter which indicates the level of resource development and management of the district. A significant analysis in the chapter is to determine the conversion of agricultural land to fisheries and its causes and impact on the environment. Some methods has also been discussed which will help to control the environmental problems caused by fishery.