CHAPTER VII
CROP COMBINATION AND CROP DIVERSIFICATION REGION

7.1 General Introduction

After unfolding the clear picture of spatio-temporal analysis of general and agricultural landuse of Jiroft watershed in Iran in previous chapter VI and VI, an attempt has made to identify physical, cultural responsible for agricultural landuse. Further the secondary crop data collected at rural district level to identify crop region by applying, crop combination and diversification methods for the study area. In the light of soil, irrigation, nature of terrain, use of chemical fertilizer, pesticides, insecticides, smalls agricultural service centers and market centers in Jiroft watershed. Keeping this situation is mind, it is necessary to make an exhaustive study of the newly delineated agricultural regions. The particular crop cultivation in certain rural district indicates strength and weakness. Individual crop grown in particular region gives realistic picture. This explains the causal relationship between landuse and related physio-socio-economic and environmental factors for the variations of crop region in study area.

For computation of crop combination, secondary data collected at rural district level was used. These data were obtained from Agricultural Service Centers of Jiroft watershed and Statistical Centre of Iran, Tehran for the year 2002-2003. Data regarding twenty-eight crops was gathered initially but the minor crops occupying less than one per cent
to their net sown area were omitted from this calculation as these crops show negligible share of cultivation in study area, and only 15 major crops were selected for the computation of crop combination and crop diversification. The data of fifteen crops has been converted in to percentage to its net sown areas of concern rural districts of the study area.

7.2 Crop Combination Regions

Crops are generally grown in combinations (Weaver, 1954). The study of crop combination of any region has gained importance in geographical study. It gives us the relative position of crops on regional scale. Farmers grow crops in varied physical and cultural condition. The pattern of crop combination gives spatial predominance of certain crops or combination resulting the emergence of crop regions. Such analysis would ultimately minimize the chances of oversimplified generalization (Ali, Mohamad, 1978). Crop combination study in geography is fruitful in many ways, firstly it provides an adequate understanding of an individual crop. Secondly, combination is in itself an integrative reality and finally crop combination regions are essential for the construction of more complex structure of vivid agricultural regions (Weaver, 1954). The study of crop combination thus forms an integral part of agricultural geography and such study is greatly helpful for regional agricultural planning. A number of quantitative and qualitative methods have been used for computing of crop combination regions. In quantitative method, crops are arranged or ranked in hierarchical order and then crop combinations are
determined. The ease of this method is the simplicity in calculation. Quantitative techniques are more precise, accurate and scientific than qualitative methods. First attempt for delineation of agricultural regions was made by Weaver in 1954. He studied crop combination for Middle west in United States. Later on, many more methods were introduced. Thomas in 1963 modified Weaver’s formula by including all crops with zero percent theoretical values in each step of the method in the crop combination studies carried out in Wales but it did not yield different results than obtained by Weaver’s method. Coppock (1964) also modified version of Weaver’s method wherein he considered the rank in recognizing the leading crops. The Weaver’s technique was subsequently modified by Doi in 1959 where he supplied one sheet of table required only the summing up of actual percentages under different crops instead of finding differences between actual percentage and theoretical distribution. Looking at this weakness, Rafiullah (1965) modified Weaver’s method and introduced a new method known as “Maximum Positive Deviation Method” by applying same statistical procedure with altogether different format. This method has been used for present study for computing crop-combination region in Jiroft watershed. The modified formula of Rafiullah is as below:

$$d = \sqrt{\frac{\sum D^2 p - D^2 n}{N^2}}$$

Where:
D= Deviation
DP = positive differences
DN = Negative differences from the medial value
N= Number of cops
The under root sign may be ignored to save labourious calculations and this formula may be used in the following form:

\[ d = \frac{\Sigma D^2 p - D^2 n}{N^2} \]

The statistical technique adopted by Rafiullah is more accurate and rational and therefore it is quite popular for delineation of crop combination regions. According to this method, percentage of area for all crops was arranged in descending order. The crops having area less than five percent were omitted from the calculation and maximum positive deviation of variance was calculated. For monoculture medial value was considered at 50 percent, for two crop-combinations it is 25 percent, three crop-combinations the value is 16.7 percent, for four it is 12.5 percent and for five crops it is 10 percent and so on. In present study area, 15 crops were used for computation of crop combination region. The obtained results of crop combination are shown in Fig. 7.1, Table-7.1. Three crop combination regions have been identified in Jiroft watershed as below:

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Combination</th>
<th>Districts</th>
<th>% of Districts</th>
<th>Area (In Hectares)</th>
<th>Area in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Monoculture</td>
<td>16</td>
<td>76.19</td>
<td>887920</td>
<td>67.04</td>
</tr>
<tr>
<td>2</td>
<td>Two Crop Combination</td>
<td>4</td>
<td>19.05</td>
<td>419570</td>
<td>31.68</td>
</tr>
<tr>
<td>3</td>
<td>Three Crop Combination</td>
<td>1</td>
<td>4.76</td>
<td>16930</td>
<td>1.28</td>
</tr>
<tr>
<td>4</td>
<td>Total</td>
<td>21</td>
<td>100.00</td>
<td>1324420</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Source: Computed by Researcher
7.1 crop combination region
7.2.1 Monoculture

Date, Orange, lemon, walnut and wheat crops have appeared as monoculture in Jiroft watershed. (Fig. 7.1 and 7.2). These five crops are identified in sixteen districts (76.19 percent to total area). Orange is leading crop in study area showing highest coverage in five districts, namely, Halil, Delfard, Saghdar, AliAbad and Mardhak (Fig. 7.1 and 7.2). It is grown 259110 hectares area. This is resulting transport and irrigation facility, climate condition favours for cultivation of orange. 29.3 total area under cultivation of orange has found in these districts. Among these, Halil district has highest area (1620 hectares) under orange. Whereas Esmaili district is leading in wheat as monoculture in south part in study area. Coarse colluvial soil with moderate irrigation favours for wheat cultivation in this district. Eighty percent of total area under wheat is seen in this district. Walnut is identified as monoculture in two districts, namely, Sarduyeh and Gevar in northern part. Lithosol soil gently slopes, and cold climate are main reasons for increasing area under cultivation of walnut. 82.3 per cent area under walnut is identified in this region. Nargesan, Garmsar and Amjaz districts have identified as monoculture in lemon crop in study area. These rural districts are located in southeast in hilly area where thin soil, moderate to cold climate and both surface and ground water irrigation majority of lemon orchards laying in valleys. 40.2 per cent of total net sown area of lemon is seen in this region. Date is grown as monoculture in five districts lying in south central part, namely.
7.2 Combination region
7.2.2 Two Crop Combination Regions

Five crops, namely, orange, date, pomegranate, wheat and barley have entered in this combination in four districts, Namely, Esfandageh, Mohammad-Abad, Rezvan and Maskun. These districts show two crop combination distributed in three patches in west, central and northeast parts in Jiroft watershed. Esfandageh district in west indicates wheat-barely combination on sierozem and coarse colluvial and alluvial soils in central and western parts of Esfandageh plain respectively. 66.1 per cent of total net sown area is under cultivation of these two crops in this plateau. Orange as dominate crop is found in three districts in central and north east parts having two crop combination it is followed by wheat in northeast (Maskun) and west (Esfandageh) parts. Orange entered with wheat as two crop combination in Rezvan in mountainous area with rugged topography, lithosol in steep and gentle slopes and sub-deep soil in wide valleys where winter wheat is well cultivated in this region. 76.9 per cent of total cropped area occupied by orange orchards and wheat filed as two crop combination in this district.

Mohammad-Abad in central part display two crop combination with orange and date where fine alluvial soils, fate surface, warm climate, irrigation and transportation facility, population density and nearness of central market are suitable for cultivation of these two crops. 64.4 per cent of total net sown area of this region is under cultivation of orange and date orchards. Orange entered in association with pomegranate as two crop combination in Maskun district. One of the most outstanding features
of land utilization in this region is the lack of arable land only small percentage of the total area of this district while most of land is under forest, pasture and steep slopes. Orange and pomegranate threes cover the largest percentage (74.8 per cent) of the total arable lands of the region. Both crops are grown on lithosols soil in valley. This region is served by national road in addition cold climate is favours for growing orange and pomegranate orchards on gently slopes and valleys in this part of Jiroft watershed.

7.2.3 Three Crop combination Regions

Potato, orange and date as cash crops have registered as three crop combination in Dowlat-Abad district in central part over 16930 hectares (1.28 per cent). Nearness to Jiroft city and central market, market demand, mechanization and agricultural implements, farmers knowledge and literacy, availability of ground water, transportation and irrigation facility, high population density, Light textured to deep soil along the rivers bed with more capability of irrigated are responsible for cultivation of these crops in this district. Dowlat-Abad has modern irrigation system by using high potentiality of ground water. Potato, orange and date as three crop combination occupied on 71.4 per cent of total net sown area of this district. Three crop combination resulting recent agricultural development of this area. Among three crops, potato is leading crop in this region (40 per cent). Alluvial clay soil is well suited for growing potato. on well-drainage fertile soil in study region.
7.3. **Crop Diversification Regions**

Crop diversification means the raising a variety of crops. The cultivation of crop depends on physical and socio-economic variables. The crops are the result of contemporary competition. Crops are diversified in the field due to erratic nature of rainfall and insufficient irrigation. The greater number of crops lead to greater competition, the higher is the magnitude of diversification. Many geographers and economists have applied diversification concept in different sense. Initially, diversification concept was applied in manufacturing field to obtain the degree of diversification by Cleann (1930), Tree (1938), Florence (1942) and Rainwald (1949). Gibbs Martin has applied diversification concept for computing measurement of diversification of employment in industry. Bhatia (1965) has computed crop diversification in India. The formula, later on, has been modified by Jasbir Singh (1976) and Ayyer (1969). According to Bhatia crop diversification means the land occupying for variety of crops, which occupy at least one percent to gross cropped area. The study of crop diversification is essential to understand the competition of crops in any region. In order to identify the crop diversification. In present study, Gibb’s Martin’s Index has been applied and computed for 103 villages in Daund tahsil. The formula is as below:

\[
\text{Index of Diversification} = 1 - \frac{\sum X^2}{(\sum X)^2}
\]

where \(X\) is the percentage of total cropped area occupied by each crop or hectareage under individual crop. If the total cultivated area in the region
is devoted wholly to one crop showing specialization, the index value will be zero (Singh, 1984).

### 7.3.1 Crop Diversification Regions By Gibbs Martin

There are three region of crop diversification has identified in Jiroft watershed by applying Gibbs Martin formula. Fig. 7.3 and Table-7.2 displays crop diversification pattern in Jiroft watershed. The maximum crop diversification appears in Garmsar district (0.88 percent) situated in southeast and lowest at Delfard (0.46) located north central part in study region. It is seen from the result Table-7.7. Study areas in divided into three crop diversification regions identified as below:

a) Area of high crop diversification region  
b) Area of moderate diversification region  
c) Area of low crop diversification region

<table>
<thead>
<tr>
<th>Types of crop Diversification</th>
<th>Index Value</th>
<th>Rural Districts</th>
<th>% of Districts</th>
<th>Cropped Area</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>0.80 to 0.88</td>
<td>11</td>
<td>53.38</td>
<td>50307</td>
<td>60.88</td>
</tr>
<tr>
<td>Moderate</td>
<td>0.60 to 0.80</td>
<td>08</td>
<td>38.09</td>
<td>29048</td>
<td>35.16</td>
</tr>
<tr>
<td>Low</td>
<td>0.40 to 0.60</td>
<td>02</td>
<td>9.52</td>
<td>3273</td>
<td>3.96</td>
</tr>
</tbody>
</table>

Source: Computed by Researcher

It is identified that largest area appears in the class of high diversification covering 60.88 percent area in Jiroft watershed. It is observed 11 districts of study region. Eight districts have found out moderate crop diversification covering 35.16 percent cropped land, whereas two districts show low diversification.
7.3 crop diversification
The area of high diversification is seen in Fig. 7.3. The maximum area having high diversification is appeared in central south and southeast parts on 50307 hectares (60.88 percent) in Jiroft watershed. Eleven rural districts (53.38 percent) falls under this highly diversified category. The index value ranges between 0.80 to 0.88. The area of moderate crop diversification covers 29048 hectares (35.16 percent to total area) of study region. Modern irrigation system, nearness to Jiroft and Anbar-Abad markets, ample power supply, and fertile soils are encouraging farmers to grow more and more diverse cash crops. Area of moderate crop diversification covers 29048 hectares (35.16 percent) of study region. Moderate diversification appears in eight districts in central, north and west parts. The districts falls in moderate diversification, namely, Mohammad-Abad, Dowlat-Abad, Rezvan and Saghdar located centrally are developed agriculturally. Whereas, northern and western part being mountainous of rugged topography and low availability of ground water are not suitable for agriculture. The crops grown in this region are less in number than the highly diversified area. Area of low crop diversification occupies 3273 hectares (3.96 percent) in two rural districts, namely, Delfard and Maskun. The land along Shur river valley is used for plantation of orange and lemon. The ragged soil and steep slopes along with less availability of water do not favour for other crops than the horticulture. The region shows predominance of coarse textured lithosol soil suffers serve erosion processes suits fruit crops. The index value ranges between 0.40 to 0.60.
In order to make agricultural regionalization in Jiroft watershed, rural districts has been considered as basic unit for in depth study to highlight crop combination and crop diversification. A number of quantitative methods have been used for computing of crop combination regions. Among them the statistical technique adopted by Rafiullah (1965) is more accurate for delineation of crop combination regions. Three crop combination regions are found in Jiroft watershed by applying Rafiullah’s methods. Date, Orange, lemon, walnut and wheat crops have entered in monoculture in sixteen rural districts covering an area of 67 per cent of total area. Orange is leading crop occupied 29.2 per cent of total area under monoculture whereas only 9.9 per cent to total area is found under wheat. Date is identified in south-central part in warm climate region where soil is sandy whereas walnut is observed in north part having cold climatic condition and rugged terrain on coarse shallow soil. Two-crop combination is identified in three isolated patches in west, central-east and east parts. Wheat-barley is occupied largest area in western part of the study region over the 81 per cent of total area where sandy loam soil is identified whereas orange-date combination is seen in central part covering an area of 6.23 percent to this combination region. Out of 21 rural districts Potato-Orange and date are found as three crop combinations in one district, namely. DowlatAbad in central part in Jiroft watershed. Gibbs Martin index applied to identify crop diversification region. According this method three crop-diversification regions have
found, namely, highest diversification, medium diversification and low diversification. High diversification region is seen in ten districts occupied 60.88 per cent of total area in central, south-central and southeast parts where low amount of rainfall and warm climatic condition is dominant. Whereas low diversification is observed in two districts in namely Delfard and Maskun in north-east part covering an area of 3.96 per cent to total area. Moderate diversification occurred in 35.16 per cent of total area in west, north and east central parts in Jiroft watershed.