

Geographical Analysis on Cultivation of Oilseed Crop for Sesame in TADA-U Township

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Abstract

TADA-U is situated in the Central Dry Zone of Myanmar. It covers an area of 363.95 square miles; the township is formed 3 wards and 61 village tracts. The township lies to the south of the Ayeyarwady River and the west of the Myitnge and Panlaung Rivers. The title of this research paper is "Geographical Analysis on Cultivation of Oilseed Crop for Sesame, In TADA-U Township". The main aim of this paper is to find out the development of sesame production in Tada-U Township. The main objective of this research is to discuss sesame production in Tada-U Township and determine the influence factors in the study area. In Tada-U Township, most of the people live in rural areas and their main occupation depends upon agricultural work. To analyze the controlling factors of sesame production, the relationship is examined between the sesame production and the physical factors (temperature and rainfall). The variation of spatial and temporal analysis is done by using qualitative and quantitative methods and graphical methods. To show the accurate findings and results, the statistical techniques are also applied in this research. In addition, this thesis may partially contribute to the development of sesame production in Tada-U Township as well as in other areas of the Mandalay Region.

Keywords: Sesame, physical factors, rural areas, occupation, accurate, applied.

Introduction

Myanmar is a significant producer of oilseed crops. Major oilseed crops in Myanmar are groundnut, sesame, sunflower, Niger and oil palm (Hla Tun Aung). The crops play an important role in Myanmar's domestic economy because of the high consumption of cooking oil compared to the neighboring countries. The amount of edible oil produced is not only sufficient for local consumption but also surplus. In the domestic market, if compared to palm oil prices that of sunflower oil is about twice, and that of sesame oil is about four times higher. In Myanmar trade, to meet local requirements of edible oil, approximately 200,000 metric tons of palm oil is imported annually.

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In Myanmar, oilseed crops are grown mostly in Sagaing Region (977,210 hectares), Magway Region (805,300 hectares), and Mandalay Region (690,340 hectares). After cereal and pulses, the oilseed crop is the third most important crop group in Myanmar agriculture and is cultivated on nearly 7.5 million acres of land. Among the oilseed crops, sesame sown area occupies 49%, groundnut 32%, sunflower 8%, oil palm 5%, Niger 5%, and mustard 1%. In 2019-2020 the total sown area of oilseed crops was 3.02 million hectares and produced 748,055 metric tons of edible oil (Moh Moh et al, 2021) and annual per capita consumption of edible oil is about 9.78 kg (6 vises). Thus the domestic edible oil requirement is about 522,984 metric tons per year for 53.38 million people and self-sufficiency is 143%. In daily food cooking and consumption in Myanmar, edible oil particularly groundnut and sesame is essential and today as their price is higher than palm oil most of Myanmar use palm oil than groundnut and sesame. However, oilseed crop growers use edible oil produced from self-cultivated sesame crops. Of the oilseed crops, sesame can be cultivated in various types of soil under the dry climatic environment and so it is cultivated in any townships of Central Myanmar. Generally, oilseed crops-cultivated areas appear to depend largely on their physical and socio-economic conditions. Particularly, physical features such as terrain, slope, relief, and soil usually influence the cultivation of crops including oilseed crops. In this study, this fact is emphasized in Tada-U Township in Mandalay Region.

Aim and Objectives

The main aim of this research is to analyze the effects of physical features upon Distribution of oilseed crops for sesame, in Tada-U Township. This study aims to understand the exploration, challenges and opportunities of integrated land use planning as a means of achieving sustainable for cultivation and spatial distribution in Tada-U Township. Major objectives are:

- To observe the physical factors mainly physical features of Tada-U Township,
- To study the human factors especially population engaged in agricultural activity of Tada-U Township,
- To examine the oilseed crops cultivation and spatial distribution in Tada-U Township and
- To analyze how physical features are related to and influence upon oil seed crops cultivation of Tada-U Township.

Study Area

Tada-U Township is one of the two townships (Tada-U and Ngazun) composed in Tada-U District. Tada-U Township is located in Tada-U District of Mandalay Region within in the Dry Zone of Central Myanmar. It lies between North Latitudes 21° 27' 4" and 21° 53' 59" and between East Longitudes 96° 4' 21" and 96° 49' 47", lying immediately south of the Ayeyarwady River and immediately west of Panlaung River and Myintnge River. It is about 11.27 kilometers from Mandalay and is adjoining to

Amarapura and Sagaing townships. With an area of 942.73 square kilometers (232,953 acres) the township is formed of three wards and 61 village tracts. The southwestern area is hilly and the rest areas are flat alluvial lowland plain on which oilseed crops, pulses and paddy are cultivated.

Research Problem

Generally slope of a land is also one of the important physiographic aspects influencing the agricultural land-use of an area. The effect of slope on agriculture may be both direct and indirect. The most direct influence of slope is the form of the restraint on cultivation and accessibility. The indirect effect of slope manifests itself in pedological and climatic modification. Practically, the fact that too steeply sloping areas cannot be brought under cultivation cannot be ignored. Increase in steepness of slope, the use of even very simple farm machinery becomes difficult.

Among the researchers in Myanmar, depending on Rainfall and Temperature U Aung (2005) and Frave and Myint (2009) mentioned that oilseed crops play an important role in Myanmar and are the second most important crops after rice. It is mentioned in the book "Assessment of Sunflower Suitability for Pyinmana Township", Department of Agriculture, Union Territory, Naypyitaw.

They mentioned that per capita consumption of edible oil in Myanmar is questionable and should be empirically estimated by launching the research-based policy and strategy formulation of edible oil sector.

Data and Methods

In this study two types of data: primary data and secondary data have been used. Primary data are collected either by doing field surveys and interviewing with local people or by means of delivering of questionnaires. Secondary data are obtained from various offices, written papers, recorded papers, journals, magazines and website. Furthermore, cultivated areas of oilseed crops are obtained from the Township Department of Agricultural Land Management and Statistics, data on soil and irrigation from the Department of Irrigation and Agriculture, population data from the Department of Immigration and Population, rainfall and temperature from Meteorology and Hydrology Department, Mandalay. Base map of the township is obtained by using UTM 1:50,000 scale maps and DEM (90 x 90) SRTM based on the map given by the Township Department of Agricultural Land Management and Statistics. Relief and drainage map and slope maps are obtained from the DEM and Google Earth Images. Per-acre yields are taken randomly from the sample sites adjusting with soil types. Depending upon these data, the effects of physical features on cultivation of each oilseed crop cultivated in Tada-U Township are analyzed by using GIS overlay method, regression method, suitable graphical method, diagram and composite method. Finally, based on the results, a generalized conclusion relating to cultivation of sesame crops will be produced.

Geography Based on TADA-U Township

Tada-U Township is located in Tada-U District in the Dry Zone of Central Myanmar. It lies on the left bank of the Ayeyarwady, Myitnge and Panlaung rivers at the confluences of the Ayeyarwady - Myitnge river confluence and the Myitnge - Panlaung river confluence. Astronomically it is located between North Latitudes $21^{\circ} 27' 4''$ and $21^{\circ} 53' 59''$ and between East Longitudes $96^{\circ} 4' 21''$ and $96^{\circ} 49' 47''$. The Mandalay - Yangon Express Way passes through the township in north-south and does the Mandalay - Myotha - Myingyan - Bagan - NyaungU road in east - west. Besides, the Mandalay International Airport lies in this township, concretely 4 miles south of Tada-U.

The study area has an area of 942.73 square kilometers or 232,951 acres. It is formed of Tada-U Town Proper and 61 village tracts, centering Tada-U. It extends for 28.8 km (17.99 miles) in east-west and 49.2km (30.77 miles) in north-south. It takes the shape of an irregular rectangle.

The study area is bordered by Sagaing Township on the north, by Amarapura, Singaing and Kyaukse townships on the east, by Myittha and Natogyi townships on the south and by Natogyi and Ngazun townships on the west. The Ayeyarwady River serves as the northern boundary and the Myitnge River, the Panlaung River and the Samon River as the eastern boundary (Map 1.1).

Tada-U Town proper is administrative seat of the township and is formed of three wards and 61 village tracts including 165 villages. Among the town and village tracts, Nachangyigon Village Tract has the largest area with 62.00 square kilometers and Hanthawady Village Tract has the smallest with 1.53 square kilometers. Areas of the town and village tracts are described in Table 1.1.

The temperatures averaged 34.21°C in maximum, 22.33°C in minimum and 28.26°C in mean. April was the hottest month and January was the coldest month with a mean temperature of 32.0°C and of 22.13°C respectively. According to the 1993- 2023 data, in this during that annual rainfall was 885 mm or 787 mm of which was received in the rainy season (May to October), particularly from the southwest monsoon wind. Tada-U Township can be identified that it has a tropical savanna type of climate (AW) according to Koppen's climate classification, Figure (1). Therefore, the conditions of temperature and rainfall may affect the well-thriving of the sesame crops.

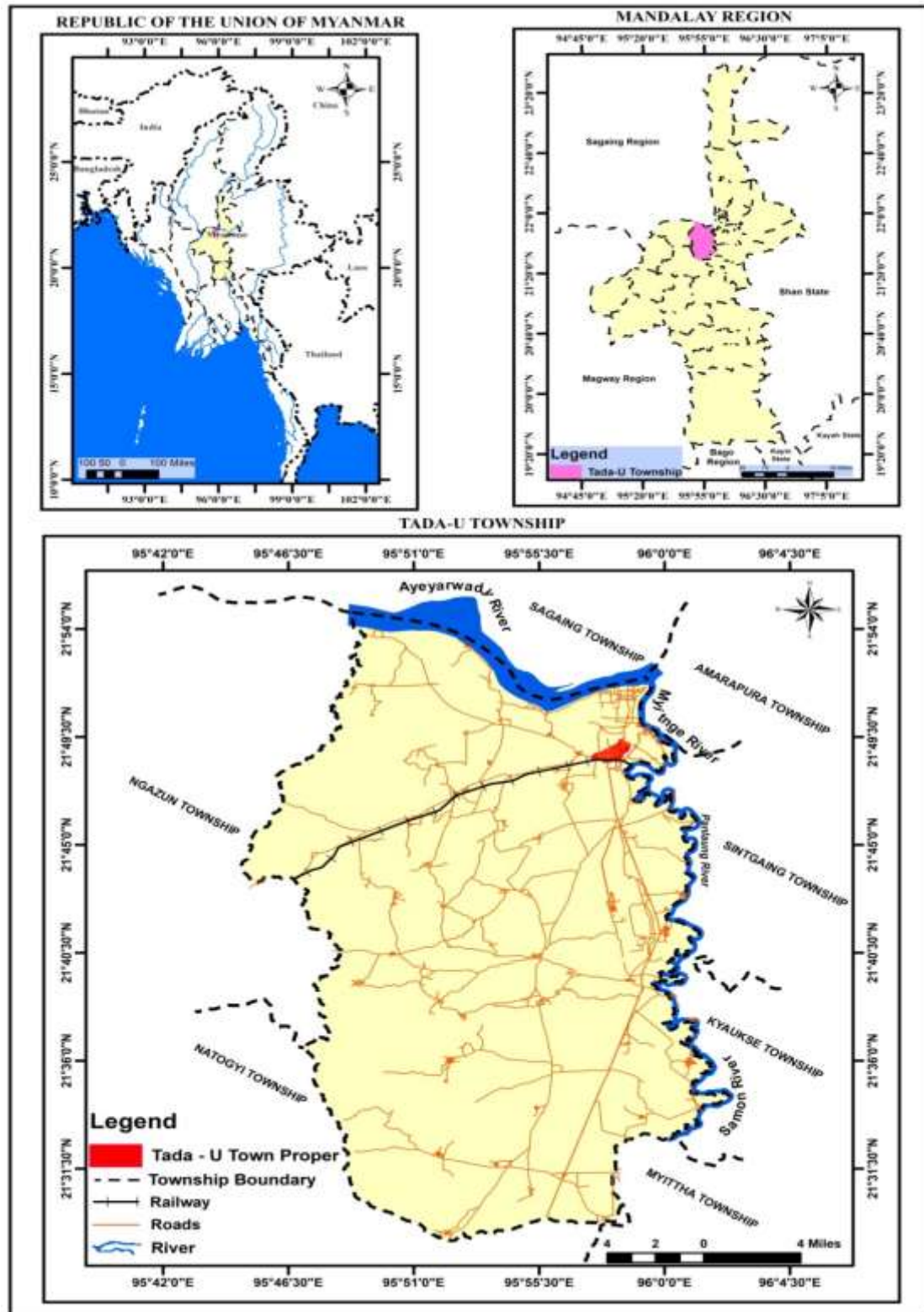


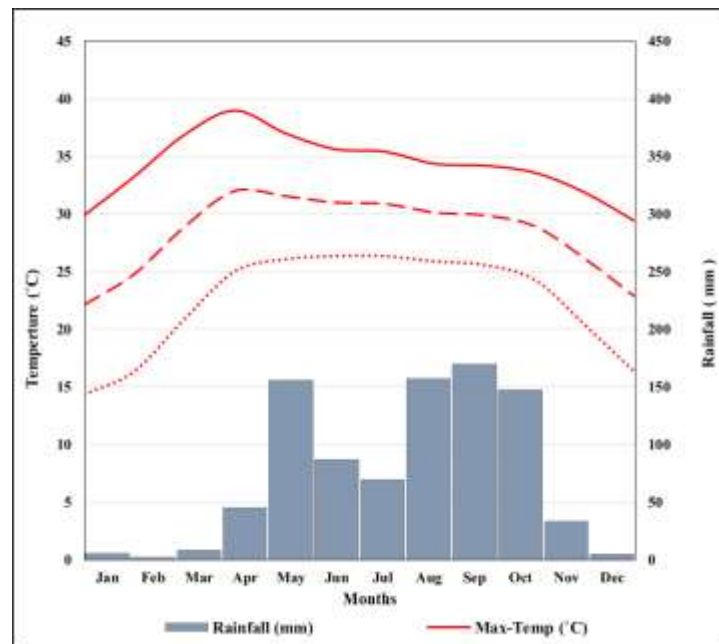
Figure (1) LOCATION OF TADA-U TOWNSHIP, MANDALAY REGION, MYANMAR

Source: UTM Map No.2195-13, 2195-14, 2195-15, 2196-01 and 2196-02

Table (1) Area of Town and Village Tracts in Tada-U Township in 2023

No.	Town and Village Tracts	Area (Sq.km)	No.	Town and Village Tracts	Area (Sq.km)
1	Tada-U	10.36	33	Gwegon	14.37
2	Ingu	22.46	34	Htanpaukgon	10.52
3	Leingon	14.40	35	Zingan	14.89
4	Thabutpin	7.23	36	Themaungkan	20.15
5	Tapae	17.92	37	Ngazinyine	19.11
6	Paukmyaing	7.36	38	Kanchaw	18.00
7	Myengu	7.95	39	Thamyarba	10.90
8	Letsaungyu	3.63	40	Pyar	21.47
9	Letpanzin	4.30	41	Lawake	4.01
10	Htaukyit	8.00	42	Chaunggwa	25.85
11	Sinde	10.64	43	Chaungzon	12.10
12	Kadoseik	10.88	44	Kyatpyin	12.67
13	Gaunggwe	9.19	45	Taungbyone	24.40
14	Zebingwe	3.03	46	Yegar	25.23
15	Ngayarpayar	3.57	47	Taungtalon	23.31
16	Methwedike	2.67	48	Kyaswe	16.52
17	Udi	3.19	49	Kabo	13.83
18	Hanthawady	1.53	50	Eingan	13.16
19	Zegyo	2.59	51	Nachaungyigon	62.00
20	Baleba	2.80	52	Sabadwin	28.39
21	Panya	7.74	53	Myaingtha	51.93
22	Thangedaw	13.47	54	Gwesaung	23.88
23	Saga-in	12.46	55	Thintein	21.19
24	Zechaung	12.15	56	Wanthagon	10.44
25	Pyukan	16.11	57	Nadawgon	22.92
26	Sagade	7.41	58	Theinnigan	21.42
27	Moenangyon	12.10	59	Myinsaing	32.89
28	Myinthe	19.76	60	Shwemoemye	20.23
29	Thinman	18.96	61	Htalondat	18.34
30	Htanaunggaing	7.12	62	Aungtha	22.01
31	Thabyegan	14.56		Total	942.73
32	Kangyi	11.21			

Source: Township Department of Agricultural Land Management and Statistics, Tada-U



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average/Total
Max.Temp °C	29.91	33.26	36.88	38.98	37.04	35.64	35.41	34.36	34.20	33.58	31.85	29.37	34.21
Mean.Temp °C	22.13	24.81	28.89	32.00	31.56	31.00	30.88	30.13	29.88	28.93	26.11	22.81	28.26
Mini.Temp °C	14.34	16.36	20.89	25.02	26.07	26.35	26.35	25.89	25.57	24.28	20.36	16.26	22.31
Rainfall (mm)	5.37	2.17	8.13	45.30	155.93	86.70	69.37	156.90	169.80	146.97	33.40	4.83	885

Figure (2). Temperature And Rainfall of Mandalay (1993-2023)

Source: Meteorology and Hydrology Department, Mandalay City

Influence of Topography and Drainage

Topographically, Tada-U Township is a plain area except the small southwestern hilly area. The study area is bounded by the rivers, concretely by the Ayeyarwady River on the north and the Myitnge River, the Panlaung River and the Samon River on the east. The plain area lies between 76m to 152m (250 to 500 feet) above sea-level. As the entire township the ground surface slightly declines from the southwest to the north and to the east. Tada-U Township can be divided into two physical divisions, namely. (1) Plain area and, (2) Upland area.

Topographically, there are two distinct relief features: the alluvial plain area and the hilly area (Map 1.1). The plain area is about one-fourth of the total area of the township. The low-lying, seasonally flooded plain area with fertile soil is suitable for the cultivation of crops. Although some places are suitable for agriculture, some are not appropriate for crop cultivation due to their rugged terrain. Upland area the remaining three-fourths of the total area lies between 250 and 1,250 feet

above sea level. It rises from 500 to 700 feet towards the southwest. There is a range in this part with an elevation of 500 to 1,250 feet. It lies in the southwestern part of the township. The alluvial plain area covers about 85% of the total township's area. From the southwestern hill area, the ground surface slightly slopes eastward and northward to the rivers. The hilly area, the southern continuation of the Minwun range, can be found in the southern part of the township and occupies 13 % of the township area. It stands between 76m-381m above sea level. The major drainage of Tada-U Township is the Ayeyarwady River. Myitnge River, Panlaung River, and Samon River play an important role in the drainage system of the study area.

Geology

Geologically Tada-U Township can be divided into three units according to stratigraphy (as shown below). Distribution of rock formation in the township is displayed in Figure (4).

Table (2). Geology of Tada-U Township

Stratigraphic Unit	Geologic Age
Alluvium	Holocene
Irrawaddy Formation	Late Miocene to Pleistocene
Upper Peguan Group	Middle Miocene

Source: Department of Geology, University of Mandalay

As the township is located on the plain built by the rivers of Ayeyarwady, Myitnge, Panlaung and Samon, a large part of Tada-U Township is formed of alluvium. In accordance with the existing soil forming factors of the township, soil types commonly found are Alluvial Soil, Red Brown Savanna Soil, Dark Compact Savanna Soil, Meadow Valley Soil and Meadow Gley Soil and Primitive Crushed Stone Soil.

Human concentrations have been on agriculture and agriculture also concentrates on people. The population of Tada-U Township was 102,136 persons in 1963, 103,147 persons in 1973, 125,029 persons in 1983 and 147,007 persons in 1993 and 147,095 persons in 2003 and 138,617 persons in 2014 and 152,646 persons in 2023. The total populations (152,646 persons) in 2023, 7.9% or 12,074 persons are living in town area and 92.1% or 140,572 persons are living in village tract areas.

Results and Discussion

Sesame Productivity

Sesame plant thrives well in the regions with annual mean temperature between 25°C and 26.7°C, and annual rainfall between 508 mm to 762 mm. Loam, Sandy Loam and Meadow Alluvial soils are suitable for sesame cultivation. Moreover, annual rainfall of the township is about 885 mm. Most

of the rainfall usually prevails in rainy season and 43.9 mm and 137.16 mm in April and May. In Tada-U Township, most of the area possesses the optimal relief, soil, temperature and rainfall conditions and thus sesame is grown in 60 village tracts and Tada-U Town Proper area except Panya Village Tract. Mean temperature of the township is about 28.26°C and so temperature is also suitable for sesame cultivation. Most of the rainfall usually prevails in rainy season and 45.21 mm and 155.96 mm in April and May. Depending upon these rainfalls, sesame begins to be cultivated in all village tracts in these months and grow well in monsoon months. Sesame particularly 96.33% of annual sesame-sown acreage is grown in monsoon season. Even in the riverine village tracts lying in the northeastern portion of the township, sesame is cultivated before July, the commencing month of the flood period. This sesame is called “Hnamhlyin” or summer sesame and sesame grown in winter season is called “Hnamgyi”.

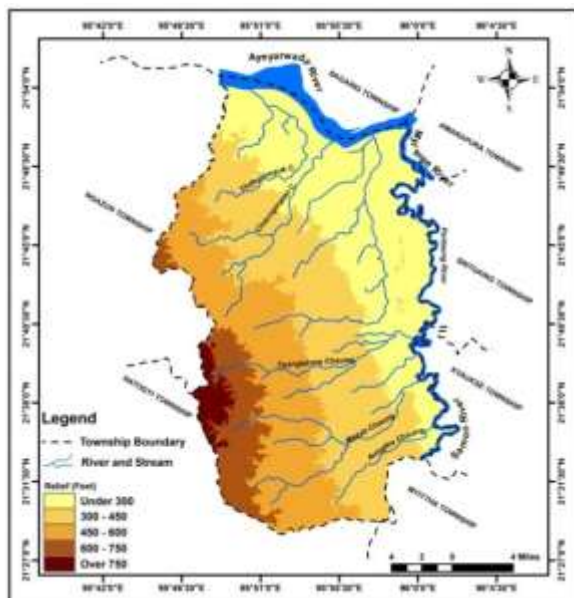


Figure (3). Relief and drainage of TADA-U Township

Source: UTM Map No.2195-13, 2195-14, 2195 -15, 2196-01 and 2196-02

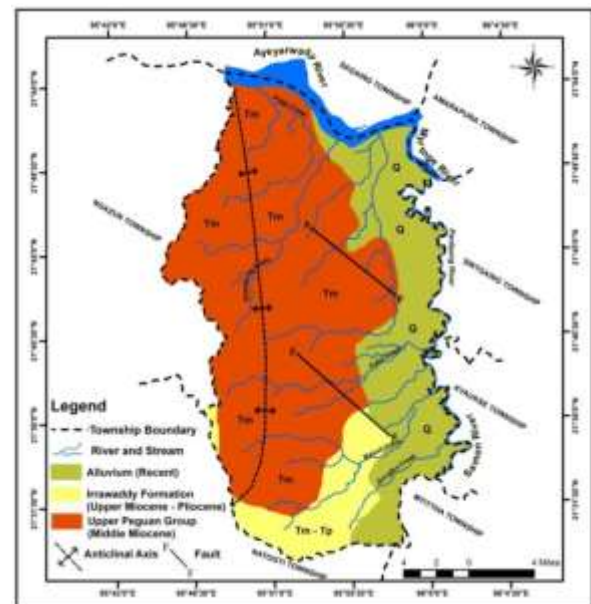


Figure (4).Geology of TADA-U Township

Source: Department of Geology, University of Mandalay

In Tada-U Township, sesame was cultivated on a total of 39,336 acres in 2023. Both types of sesame, “Hnamhlyin and Hnamgyi”, are grown. Hnamhlyin is mostly cultivated in all of the town and village tracts of the township and occupies 96.33% of the total sesame-sown acreage of the township whereas Hnamgyi is cultivated in Tada-U Town Proper and 19 village tracts.

In 2023, it was cultivated in village tracts of, in descending order, Themaungkan, Ngazinyine, and Pyar each with more than 150 acres, Eingan and Myinsaing village tracts with 100-150 acres and Nwachangyigon, Kabo, Taungtalone, Htanlondat, Aungtha, Kanchaw, Kyaswe, Lawake, Yegar, Kyatpyin, Chaungzon, Thamyaba, Taungbyone, Chaunggwa and Tada-U Town Proper each with less than 100 acres

and harvested in weeks of late February. Generally oil output per acre of Hnamhlyin ranges from 2.5 viss to 3.5 viss per basket. In 2023, the total Hnamgyi production was 13,631 baskets. Sown acres of sesame Hnamlyin and Hnamgyi are described by village tracts in Table (3), in which sesame sown acres are described by groups. Distribution by groups is depicted in Figure (4).

There were two village tracts with more than 2,000 acres of sesame (14.86%), one village tract that is 4.04 percent with 1,501 - 2,000 acres, 14 village tracts with 1,001-1,500 acres of sesame (42.07%), 13 village tracts with 500 - 1,000 acres of 24.34% and 31 village tracts with less than 500 acres of (14.7%). These village tracts with below 500 are less productive because they grow more legumes and pulses.

Table (3). Distribution of Sesame Sown Acreage of Tada-U Township in (2023)

Sesame-Sown Acres	Village Tracts (VTs) Growing Sesame	No.of V.Ts
> 2,000	Nwachangyigon, Myinsaing	2
1,501-2,000	Nwatawgon	1
1,001-1,500	Gwesaung, shwemoemye, Taungbyone, Zigan, Yegar, Pyar, Theinnikan, Aungtha, Kangyi, Chaunggwa, Thabyekan, Thaman, Gwekone, Kyaswe	14
500-1,000	Htalondat, Sabadwin, Eingan, Myinthe, Kabo, Htanpaukgon, Kyatpyin, Ingu, Htanaunggaing, Thintein, Myaingtha, Chaungzon, Ngazinyine	13
<500	Themaungkan, Myengu, Leingon, Pyukan, Taungtalon, Thangedaw, Wanthagon, Lawake, Tapel, Moenangyon, Kanchaw, Thabutpin, Sgade, Paukmyaing, Thamyarba, Htaukyit, Zechaung, Gaunggwe, Sinde, Letpanzin, Tada-U, Kadoseik, Letsaungyu, Saga-in, Zebingwe, Ngayarpyar, Zegyo, Methwedike, Hanthawady, U-di, Baleba	31

Source: Department of Agricultural Land Management and Statistics, Tada-U Township

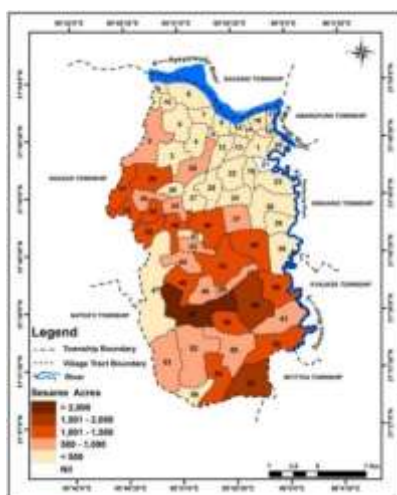


Figure (5). Distribution of sesame-cultivated areas in TADA-U Township 2023

Source: Based on Table 1.3

Regarding producing of edible sesame oil in Tada-U Township, it is observed that a basket of sesame produces from 5 viss to 7 viss of edible oil, in average about 6 viss of edible oil. In 2023, the entire township could produce a total of 1,400,214 viss of sesame oil. Local need or consumption for the total population of 152,646 persons amounted to 915,876 viss a year (at a rate of consumption 6 viss of oil per person a year). Therefore, it can be noted that 1.53 times the local consumption of edible oil could be produced from sesame production in Tada-U Township in 2023.

In this analysis the spatial distribution of oilseed cultivated areas are investigated by using Bhatia's (1965) concentration method as shown below.

$$\text{Index of Concentration crop} = \frac{\text{Area of crop X in a component areal Unit}}{\text{Area of all crops in the component areal unit}} \div \frac{\text{Area of crop X in the entire region}}{\text{Area of all crops in the entire region}}$$

In this case, "Area of crop X in a component areal Unit" in the formula refers to "individual oilseed-cultivated acreage of a village tract", "Area of all crops in the component areal unit" to "total cultivated acreage of individual oilseed crop of the village tract", "Area of crop X in the entire region" to "total individual oilseed crop cultivated acreage of the entire township" and "Area of all crops in the entire region" to "total cultivated area of all crops in the entire township".

Conclusion

Tada-U Township is situated in the Central Dry Zone of Myanmar and is also located south of the confluence of Ayeyarwady- Myitnge Rivers; west of the confluence of Myitnge- Panglaung Rivers. The drainage system of Tada-U Township is fairly crops. The main rivers are Ayeyarwady in the north, Myitnga, Panglaung, and Sammon Rivers are in the east. They flow as the boundary in the north and east respectively. Other small streams and creeks are flowing from west to east and northeast of the township.

Generally, the soils of the whole township are composed of compact soil which is classified into five types Alluvial Soil, Red Brown Savanna Soil, Dark Compact Savanna Soil, Meadow Valley Soil, and Meadow Gley Soil and Primitive Crushed Stone Soil most the alluvial soils are found in the northernmost part township, especially under flooded area by Ayeyarwady and Myitnge Rivers.

According to Koppen's classification of climates, Tada-U Township experiences the Tropical Savanna type of climate (Aw). The total of (13) crops, such as paddy, groundnut, sesame, sunflower, gram, pulses, maize, cotton, wheat, millet, onion, chili and vegetable are cultivated. Among them, Pulses is found to be the largest sown crop with (75,419 acres). The second most grown crop in the study area is that of the sesame with (50,976 acres).

In the study area the physical feature, the governmental policy, the market demand, and irrigational conditions are the major determining factors in practicing the crop combination. So Tada-U Township may be an economically well-developed area.

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