

Analysis on Relationship between Irrigation and Paddy Production in Tabayin Township

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Abstract

This research is the study on analysis of the relationship between irrigation and paddy production which lie in Shwebo District of Saging Region. The study area is located between North Latitudes 22° 22' and 22° 43' and East Longitudes 94° 55' and 95° 32'. The plain consists of 46.19% of the agricultural land. The western region includes 53.81% of the agricultural land. The major drainage of the study area is Mu river. According to Koppen's classification, the 30-year data from 1988 to 2017 show that Tabayin township has a Aw type of climate or Tropical Savanna. The research shows that paddy species commonly grown in the township are *Shwebopawsan*, *Ayeyarmin*, *Shwethweyin* and *Palethwe*. Regarding per-acre yield rates, it is found, in average, to be 77.39 baskets in Monsoon *Shwethweyin* and 84.64 baskets in Summer *Shwethweyin*. This shows that the yield of summer paddy is greater than that of Monsoon paddy. The relationship between paddy irrigation intensity and paddy output (production) reveals a low degree of positive correlation.

Key words: irrigation, paddy, intensity.

Introduction

Tabayin Township is situated in Shwebo District within Sagaing Region. It lies in the Central Dry Zone of Myanmar Naing Ngan. It has become a popular township for paddy cultivation with the help of irrigation system. Depending upon flat topography and soil types, the township is still important in agriculture. Paddy is one of the major users of world's developed fresh water resources since it is widely grown under irrigation. Paddy cultivation can be done under irrigated (lowland) or rain-fed (upland or lowland) conditions all over the world. In the study area rain-fed paddy cultivation is being practiced in the *In*'s coastline area or in the land-water marginal area and majority of paddy cultivation is done by canal irrigation. Lowland paddy cultivation in the township is commonly transplanted or direct (wet) seeded into the paddy fields which are puddled. This research studies the relationship between irrigation and paddy cultivation.

Aim

The main aim is to investigate the relationship between irrigation and paddy production of Tabayin Township.

Objectives

The objectives are

- To study the spatial distribution of irrigated area,
- To observe the irrigated paddy cultivation and production,
- To examine the different conditions in paddy cultivation and production, and
- To analyze the relationship between irrigation intensity and paddy cultivation or paddy production.

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The Study Area

Tabayin Township is situated in Shwebo District within Sagaing Region. It lies in the Central Dry Zone of Myanmar between north latitudes of 22° 22' to 22° 43' and east longitudes of 94° 55' to 95° 32' (Figure1).

The township is bounded on the north by Ye-U Township, on the west by Kani Township, and on the south by Ayadaw and Budalin Townships. The eastern boundary of the township is demarcated by Mu River which is flowing from north to south. This boundary is connected for about 16 miles with the townships of Khin-U, Shwebo and Wetlet.

Tabayin Township is narrow in north-south and long in east-west direction with 6 miles at its narrowest and 16 miles at its widest, respectively. It has an area of 511.85 square miles or 327,583 acres, with a 50 miles length in east-west. The township is formed of 2 wards and 197 villages lying within 56 villages tracts (Figure 2).

Relief of Tabayin Township can be divided into two (Figure3). One is plain and another is western hilly region. The plain consists of 46.19% of the agricultural land .The western region includes 53.81% of the agricultural land. The major drainage of the study area is Mu river. The Mu river is flowing along the eastern boundary from northwest to southeast, about a 16 mile distance. It supplies water to the Shwebo and the Ye-U canals. After floods, it deposits new alluvium on the flood areas. Being favorable for agriculture such alluvium is fertile and productive.

It is assumed that climatic conditions of a region influence not only upon its topography and drainage but also upon the facts of irrigation, paddy production, soil

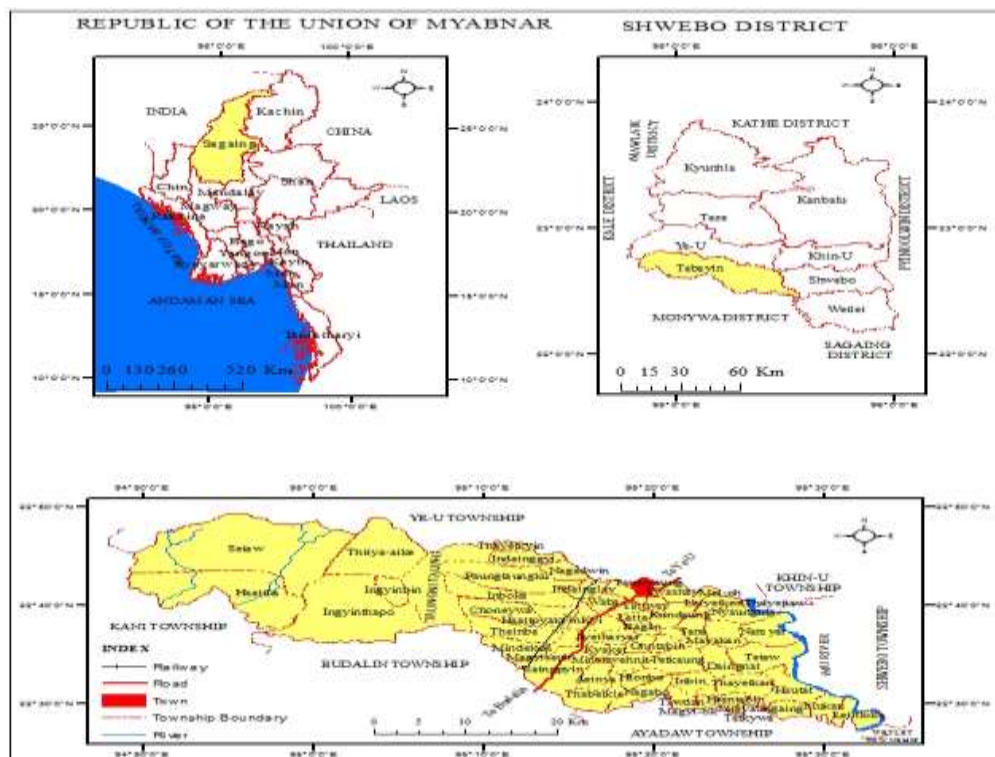


FIGURE 1 LOCATION OF TABAYIN TOWNSHIP

Source: Topographic Map No. 2295-01,2295-02,2295-05,2295-06.

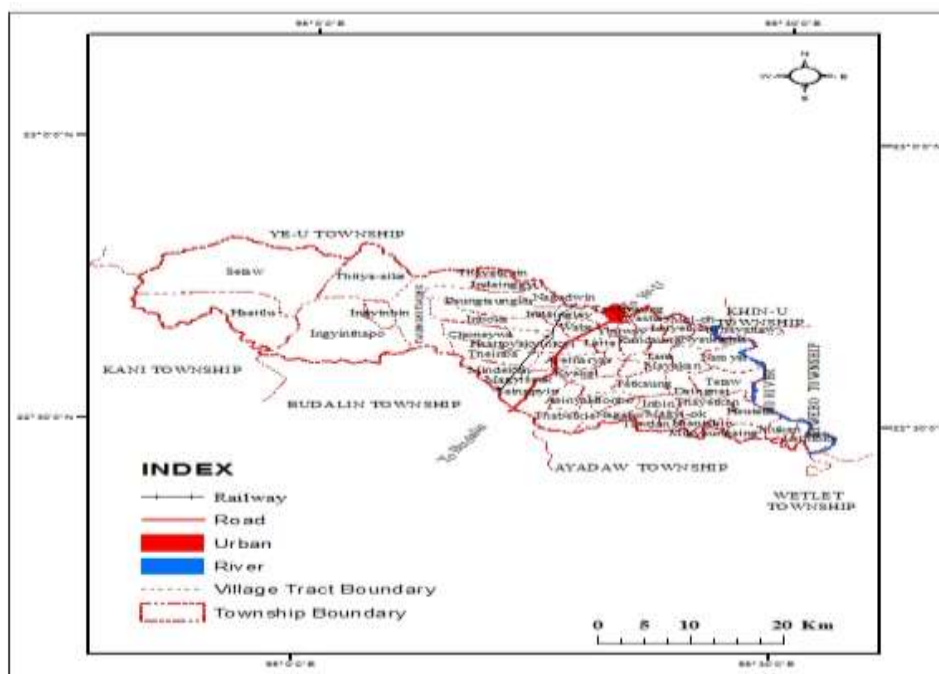


FIGURE 2 VILLAGE TRACTS OF TABAYIN TOWNSHIP

Source: Land Management and Registration Department, Tabayin Township.

development, and natural vegetation. Since there is no meteorological station in Tabayin except rain gauge, data on temperature and humidity of Ye-U which is 9 miles northeast, are used for this township in combined consideration of similarity of relief between the two townships. According to the 1988-2017 Meteorological data in the study area, the hottest month is April and the coldest month is December, 100.1°F and 83.2°F in average maximum temperature and 73.3°F and 59.2°F in average minimum temperature and 86.7°F and 71.2°F in average mean temperature, respectively. During this period, yearly temperature were 91.44°F in Maximum, 70.24°F in minimum and 80.84°F in mean temperature (Figure 4). According to 1988-2017 climatic data, average annual rainfall is 40.19 inches. During this period, the highest annual rainfall occurred in 1994, amounting to 60.66 inches and the lowest annual rainfall was found in 2012 with 14.19 inches. The least average monthly heaviest monthly rainfall was recorded in December with 0.17 inch and the heaviest monthly rainfall in September with 9.54 inches. According to Koppen's classification, the 30-year data from 1988 to 2017 show that Tabayin Township has a Aw type of climate or Tropical Savanna.

Soil types of Tabayin Township can be divided into six, according to the soil classification of Food Agricultural Organization (Figure5). They are as follows: meadow alluvial soil (Gley soil and Fluvisol), dark compact savanna soil (Vertisol), red brown savanna soil (Catena of Luvisol), yellow brown forest soil and red brown forest foil (Ferrasol), red brown savanna and dark compact savanna soil catena (Catena of Luvisol and Vertisol) and primitive crushed stone soil (Lithosol). The meadow alluvial soil occurs along the Mu valley of the eastern part. The dark compact savanna soil is found in 35 village tracts irrigated from main Ye-U canal and Mayakan branch canal. The red brown savanna soil is common in southeastern part of the township. The yellow brown forest soil and red brown forest soil are widespread in the westernmost part of the township. The red brown savanna soil and dark compact savanna soil vary with terrain from place to place. It exists in the middle of the township. The primitive crushed stone soil is mostly found in both sides of southernmost part of Ye-U – Budalin road. The soil is easily eroded by wind and water. As a result, it cannot be used for cultivation.

Data Collection and Methodology

Primary data are collected by field observation, by interviewing, by interpreting from the Google Earth Images whereas the secondary data are obtained from the respective

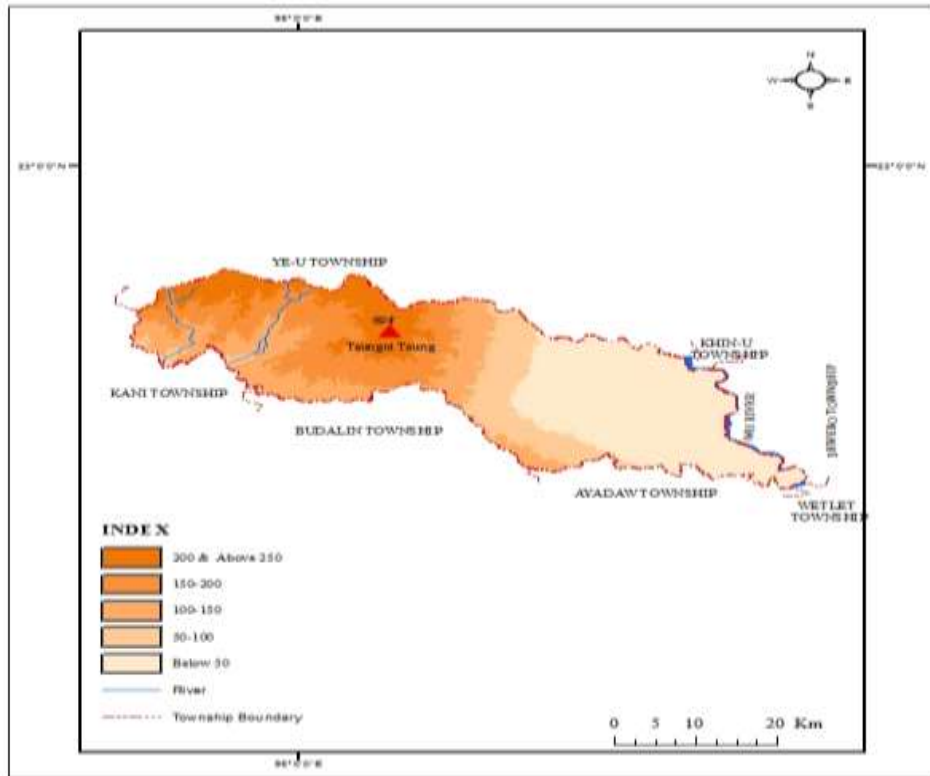


FIGURE 3 TOPOGRAHY AND DRAINAGE OF TABAYIN TOWNSHIP
 Source: Topographic Map No.2295-01,2295-02,2295-05,229506.

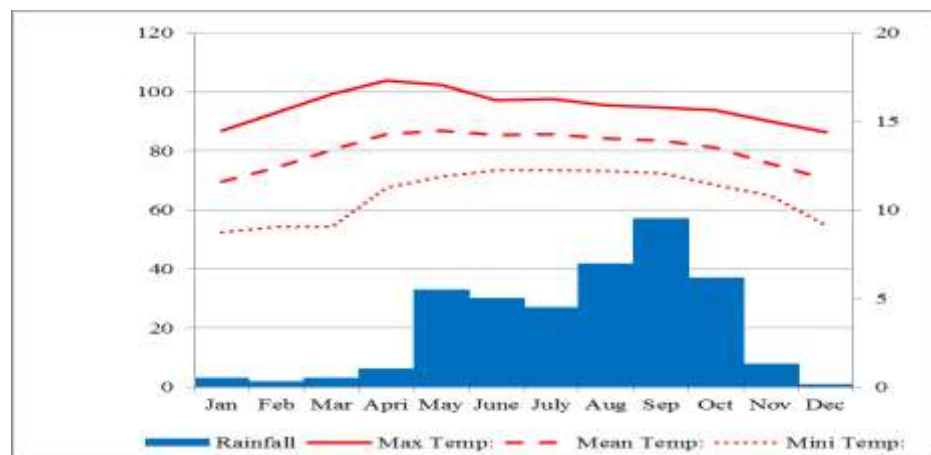


FIGURE 4 TEMPERATURE AND RAINFALL GRAPH OF YE-U

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Avg/Total
Max	83.40	88.55	95.35	100.10	98.65	94.35	94.00	91.95	91.30	90.05	86.40	83.20	91.44
Mean	70.03	74.50	81.05	86.70	87.75	86.00	85.90	84.65	83.88	81.98	76.48	71.20	80.84
Mini	56.65	60.45	66.75	73.30	76.85	77.65	77.80	77.35	76.45	73.90	66.55	59.20	70.24
Rainfall	0.51	0.30	0.53	1.02	5.51	5.00	4.48	6.98	9.54	6.18	1.33	0.17	40.19

Source: Meteorology and Hydrology Department, Mandalay.

governmental departments. Data on irrigated areas and their spatial distribution are collected from the Irrigation Department, the Township Department of Agricultural Land Management and Statistics, and Google Earth Maps. Irrigation method and paddy-cultivation system are examined under the field observation, and then the collected data are processed into the appropriate form or tables. Then the processed data are analyzed by statistical method or graphical method, GIS overlay method, and other suitable methods. Finally, the results are conducted into a generalization.

Analysis on Relationship between Irrigation and Paddy Production

In Sagaing Region, Tabayin Township is a moderately populated one. According to the censuses, township's population totaled 89,843 in 1973 and 140,852 in 2017, with an increase of 51,009 during such 45 year period, or with an annual increasing rate of 1.26 per cent.

Tabayin Township relies mainly on agriculture and thus more people live in rural area than in urban area. Depending upon relief, economic activities and transportation facilities, distribution of population differs from one place to another. It is densely populated in riverine area of the Mu valley and on both sides of the Ye-U-Monywa road as these region have better transportation and fertile productive soil.

On contrary to it, the western part of the township is sparsely populated. It is due to not only abundance of forests and virgin lands but also existence of rain-fed area of hilly region. Village tracts with the least population are Pauktaw (546 persons) and Mei-oh (652 persons) which lie in the northeastern part of the township, as a result of a great use as agricultural land in smaller village tracts' areas. Village tracts with the densest population are Thayetkyin (7,803 persons), Tetaw (6,464 persons), and Namyar (6,326 persons). As they are situated along the Mu river and on northern part of the township, economic status of the village tracts is higher than that of other village tract. This is why these three village tracts are densely populated.

Regarding population density of the township, it increased year after year amounting to 176 persons per square mile in 1973 and 275 persons in 2017. According to the year 2017, the largest density of population went to Pauktaw village tract (6,341 persons per square mile), Taungpyin ward (3,111 persons per square mile), whereas the smallest density went to Ingyinthapo village tract with 26 persons per square mile and Hsatlu village tract with 30 persons per square mile. The latter two are large in area but small in total population. Therefore, they had the smallest density.

Tabayin is an agricultural based township. Therefore, most of people live in rural areas. As to the data, out of the total population of 140,852 residents in 2017, 4.8 per cent was urban settlers and 95.2 per cent was rural settlers.

Tabayin Township has a total area of 327,583 acres. Of these, agricultural land occupies the largest area with 244,145 acres (74.53 % of the total township's area). The second largest area is barren and uncultivable waste land with a total of 41,084 acres (6.76%) while the third largest is land under water with 14,473 acres or 4.42% and the fourth largest is urban and rural village land with 7,136 acres or 2.18%. Other types of land use are, in descending order of area, road and railroad land (2,560 acres or 0.78%), reserve forest land (2,163 acres or 0.66%), religious and cemetery land (1,722 acres or 0.53%), industrial land (53 acres or 0.02%), and the remaining unidentified lands (14,247 acres or 4.34%).

The total agricultural land use types of the township include *Le* land, *Yaland*, *Kaingkyunland* and garden land. Of the total agricultural land, the largest land use occurs in *Le* land with 119,349 acres (36.4% of the total township's area or 48.88% of the total agricultural land), the second largest in *Ya* land with 117,151 acres (35.73% of the total township's area or 47.98% of the total agricultural land), the third largest in garden land with 7,397 acres

(2.26% of the township’s area or 3.03% of the total agricultural land) and the fourth largest in *Kaing-kyunland* with 248 acres (2.26% of the township’s area or 0.01% of the total agricultural land (Figure 6).

Actually irrigable acres in the township are 112,526 acres by Ye-U Canal and 27,900 acres by Right Canal. Among the actually irrigable acres, the largest acreage is occupied by Tetkaung village tract with 5,914 acres, the second largest acreage by Kyi village tract with 5,309 acres ,and the third largest acreage by Tetaw village tract with 5,202 acres. The least acreage is Lethloke village tract with 203 acres. 6 village tracts are not found by irrigation. They are Thayetkyin, Ingyinbin, Thitya-aike, Ingyinthapo, Hsattlu and Setaw village tracts.

The study area does not get enough rainfall for cultivation of paddy. Agricultural landscape helps to maintain commercial farming. Thus it becomes essential to redistribute rain water in order to compensate for the inadequate rain during the growing season. Since ancient time, irrigation has been practiced in the study area through canals. Sometimes

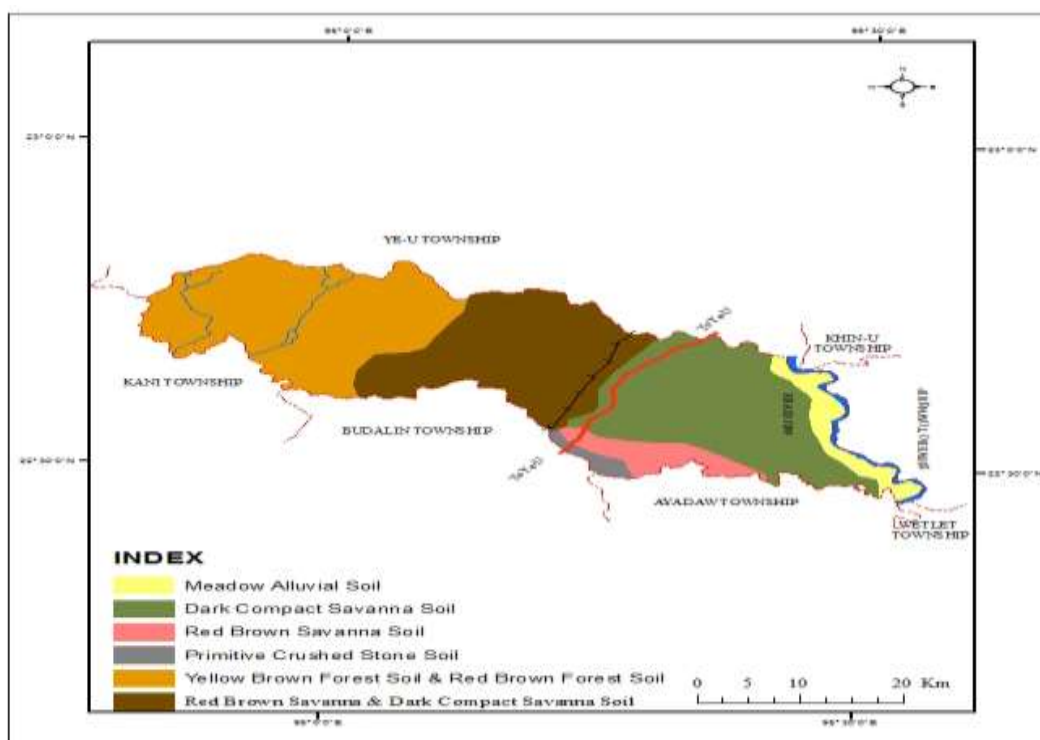


FIGURE 5 SOIL TYPES OF TABAYIN TOWNSHIP

Source: Survey Department, Yangon.

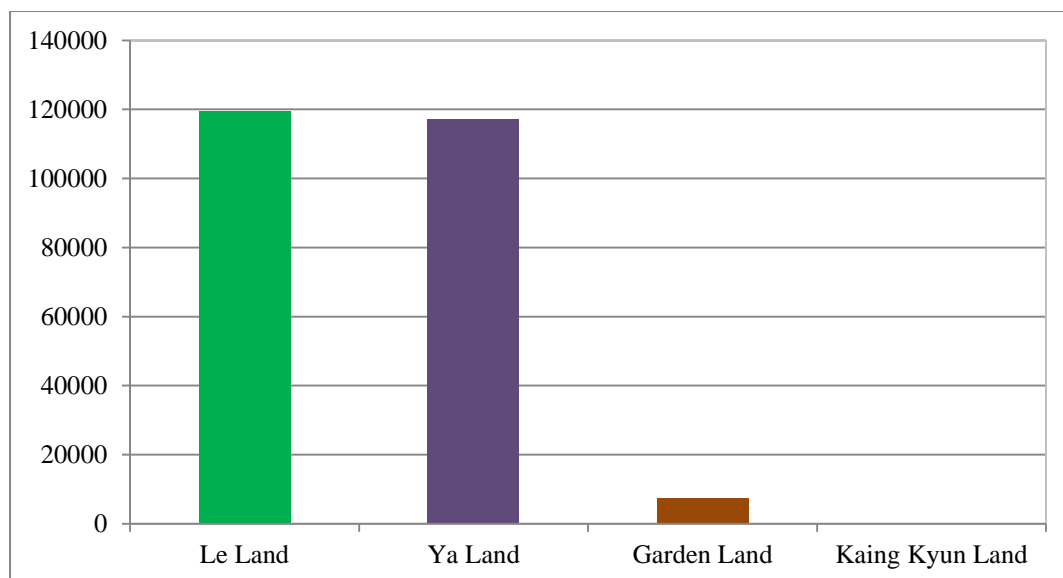


FIGURE 6 AGRICULTURAL LANDUSE TYPES OF TABAYIN TOWNSHIP

Source: Land Management and Registration Department, Tabayin Township.

unfavourable rainfall which prevails in the area adversely affects the agricultural landscape. The irrigation intensity is calculated by using the following formula (Singh & Dhillon, 2004, pp.119-120).

$$\text{Irrigation Intensity} = \frac{\text{Irrigated Cropped Area}}{\text{Net Sown Area}} \times 100$$

According to the formula, Irrigation intensity by village tract of Tabayin Township is calculated and is described in Table 1 and Figure 7. According to the calculation, the highest irrigation intensity in the township is found in Mei-oh village tract with irrigation intensity of 184.85, the second highest in Taungpyin with 182.80 of irrigation intensity, the third highest in Mayakan village tract with 181.63 and the fourth in Yintway village tract with 178.86. The smallest irrigation intensity is found in Ingyinthapovillage tract with 5.73. According to the map, it is found that the village tracts with irrigation intensity higher than 175 are between Ye-U and Letyar Irrigation Canals, 125 ~175 of irrigation intensity in 19 village tracts namely Kundaung, Tabayin (Town Proper), Tawkyauang, Minshwehntit, Waba, Lette, Kyi, Kyaket, Ohntabin, Htantabin, Thayetkan, Daingnat, Inbin, Namyarm, Tane, Takkashut and Bagan, 75~125 irrigation intensity in 16 village tracts such as Tetkaung, Kaingkan, Tetaw, Pauktaw, Indainglay, Nagadwin, Htonbo, Taikywa, Magyisauk, Magyi-ok, Tawdan, Hsattpyakyin, Nagabo, Hsutat, Migyaungaing and Thayettaw, 25~75 of irrigation intensity in 12 village tracts of Theinba, Aeinya, Thabeikle, Saingpyin, Thayetkyin, Inboke, Mindekon, Indainggyi, Mukan, Paungtaungku, Lethloke and Choneywa and < 25 of irrigation intensity in 5 village tracts such as Setaw, Ingyinbin, Thitya-aike, Hsattlu and Ingyinthapo.

In Tabayin Township paddy is cultivated in monsoon season and summer season (Table 2). Being located in the Dry Zone of Central Myanmar, the township has to cultivate paddy with the help of irrigation. In the “Le” land, paddy could be cultivated in 119,349 acres only. Commonly grown paddy varieties are *Shwethweyin* (89,510 acres), *Shwebopawsan* (54,601 acres), *Ayeyarmin* (37,559 acres), and *Palethwe* (12,383 acres). Among the total sown acreage, 126,553 acres were under monsoon paddy and 67,500 acres under summer paddy. Paddy varieties mostly grown in monsoon season are *Shwethweyin*, *Shwebopawsan*, and *Ayeyarmin* whereas *Shwethweyin* and *Palethwe* are those usually grown in summer. Generally monsoon paddy varieties are cultivated in August and summer paddy varieties in March. Those are harvested after 135 ~ 145 days later, particularly in January and February.

Table 1 Irrigation Intensity of Tabayin Township (2016-2017)

No	Wards/Village Tract	Net Sown Acreage (C)	Total Paddy Sown Acres (D)	Irrigation Intensity (D/C)*100
1	Mei-oh	1848	3416	184.85
2	Taungpyin	471	861	182.80
3	Mayakan	4420	8028	181.63
4	Yintway	1282	2293	178.86
5	Letyetkon	1542	2721	176.46
6	Ywashay	2245	3930	175.06
7	Nyaungghla	2654	4612	173.78
8	Kundaung	3010	5190	172.43
9	Tabayin (Town Proper)	2084	3553	170.49
10	Tawkyang	1343	2244	167.09
11	Minshwehntit	2355	3857	163.78
12	Waba	1758	2837	161.38
13	Ayetharyar	2949	4671	158.39
14	Lettee	1865	2912	156.14
15	Kyi	3763	5642	149.93
16	Kyaket	2163	3241	149.84
17	Ohntabin	1947	2907	149.31
18	Htantabin	1909	2759	144.53
19	Thayetkan	5601	7925	141.49
20	Daingnat	4450	6149	138.18
21	Inbin	3160	4364	138.10
22	Namyar	4822	6303	130.71
23	Tane	3395	4334	127.66
24	Taukkashut	1733	2193	126.54
25	Bagan	2023	2550	126.05
26	Tetkaung	5142	6365	123.78
27	Kaingkan	967	1157	119.65
28	Tetaw	7658	9092	118.73
29	Pauktaw	810	950	117.28
30	Indainglay	3298	3666	111.16
31	Nagadwin	3399	3700	108.86
32	Htonbo	3829	4156	108.54
33	Taikywa	2988	3122	104.48
34	Magyisauk	2262	2301	101.72
35	Magyi-ok	1651	1652	100.06
36	Tawdan	2158	1850	85.73
37	Hsattpyakyin	4738	3819	80.60
38	Nagabo	4833	3834	79.33

No	Wards/Village Tract	Net Sown Acreage (C)	Total Paddy Sown Acres (D)	Irrigation Intensity (D/C)*100
39	Hsutat	8554	6686	78.16
40	Migyaungaing	4038	3085	76.40
41	Thayettaw	905	680	75.14
42	Theinba	5440	3982	73.20
43	Aeinya	2282	1463	64.11
44	Thabeikle	5220	3234	61.95
45	Saingpyin	6288	3862	61.42
46	Thayetkyin	1991	1170	58.76
47	Inboke	7905	4637	58.66
48	Mindekon	4350	2409	55.38
49	Indainggyi	4987	2722	54.58
50	Mukan	3809	1758	46.15
51	Paungtaungku	7091	3091	43.59
52	Lethloke	5587	1675	29.98
53	Choneywa	7771	2098	27.00
54	Setaw	20692	1708	8.25
55	Ingyinbin	12809	1016	7.93
56	Thitya-aike	16167	1147	7.09
57	Hsattlu	19462	1358	6.98
58	Ingyinthapo	19482	1116	5.73
	Total	273355	194053	70.99

Source: Self-calculation .

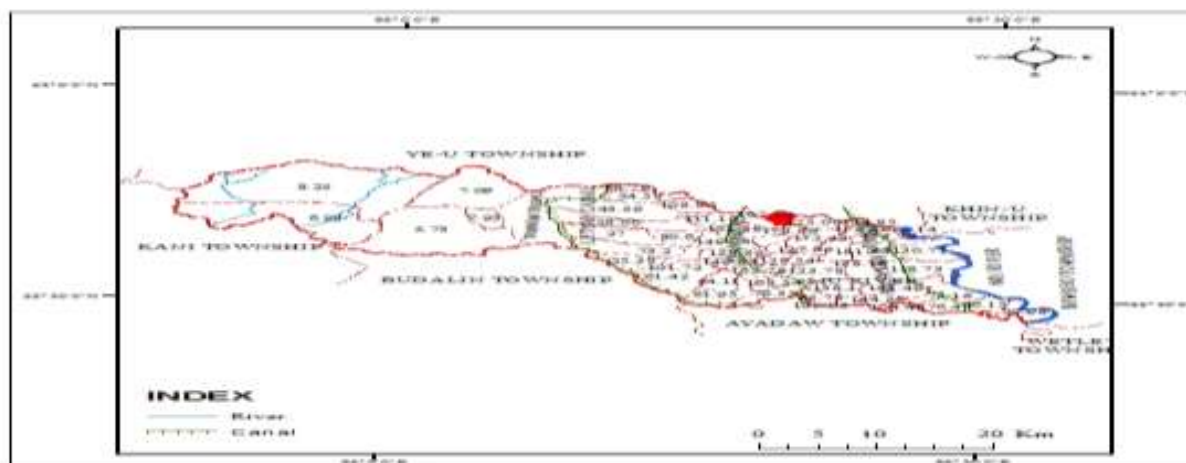


FIGURE 7 SPATIAL DISTRIBUTION OF IRRIGATION AND VILLAGE TRACT WISE IRRIGATION INTENSITY IN TABAYIN TOWNSHIP

Source: Based on Table 1

Table 2 Paddy Production (baskets) in Tabayin Township (2016-2017)

No	Wards /Village Tracts	Monsoon Paddy						Total Production	Summer Paddy				Total Production	Year Round Total production	
		Shebopawsan		Ayeyarmin		Shethweyin			Yield/Acre	Production	Paethwe				Total Production
		Yield/Acre	Production	Yield/Acre	Production	Yield/Acre	Production				Yield/Acre	Production			
1	Tabayin (Town Proper)	84.89	75128	84.91	51795	101.85	56832	183755	106.00	13674	145.00	39730	53404	237159	
2	Taungpyin	83.50	16617	84.00	11508	101.00	12625	40750	106.62	13754	146.15	10523	24277	65027	
3	Tawkyauung	82.75	44354	83.75	30988	99.50	33631	108973	101.50	13094	139.00	25298	38392	147365	
4	Ywashay	80.50	73980	81.50	51508	98.75	57176	182664	102.25	13190	138.25	45484	58675	241339	
5	Mei-oh	82.50	61298	82.50	42158	100.50	46934	150390	103.75	13384	137.50	42488	55871	206261	
6	Letyetkon	81.00	48195	83.00	33947	100.75	37781	119923	105.75	13642	136.65	33616	47258	167181	
7	Thayettaw	84.00	14364	81.00	9558	77.50	8370	32292	105.45	13603	133.50	6942	20545	52837	
8	Nyaungghla	83.75	87854	80.75	58221	77.90	51492	197567	105.00	13545	134.75	53900	67445	265012	
9	Namyar	84.50	127088	81.00	83835	78.75	74576	285499	104.00	13416	135.00	69795	83211	368710	
10	Mayakan	82.50	150810	79.00	99382	78.25	90066	340258	104.75	13513	140.75	97821	111334	451592	
11	Tane	81.00	100764	79.50	68052	76.25	59780	228596	104.50	13481	140.50	37373	50854	279450	
12	Kundaung	81.50	101631	68.50	58773	76.50	60053	220456	104.25	13448	141.25	59608	73056	293512	
13	Pauktaw	82.00	24764	68.75	14300	77.50	14725	53789	103.50	13352	142.50	6555	19907	73696	
14	Ohntabin	81.20	56272	67.50	32198	77.75	33977	122447	103.25	13319	143.75	34213	47532	169979	
15	Tetkaung	80.60	151770	67.55	87545	75.25	89247	328562	100.00	12900	143.25	52573	65473	394035	
16	Daingnat	79.50	145167	66.00	82962	75.75	87113	315242	100.50	12965	142.50	50018	62983	378225	
17	Tetaw	80.75	198484	66.50	112452	73.50	113778	424714	97.50	12578	142.25	88622	101200	525914	
18	Thayetkan	81.60	168994	65.25	92981	73.75	96170	358145	96.25	12416	132.25	75779	88195	446340	
19	Hsutat	82.65	145877	65.75	79821	73.25	81381	307079	95.50	12320	132.00	62832	75152	382231	
20	Lethloke	81.35	58816	64.00	31808	74.25	33784	124408	0.00	0	0.00	0	0	124408	
21	Mukan	83.50	63293	64.75	33800	74.50	35611	132704	0.00	0	0.00	0	0	132704	
22	Migyaungaing	79.50	76002	64.50	42377	74.90	45090	163469	95.00	12255	129.00	20640	32895	196364	
23	Taikywa	78.50	60053	63.75	33533	72.25	34752	128338	94.00	12126	128.75	31930	44056	172394	
24	Htantabin	76.50	53168	63.50	30290	72.15	31530	114988	93.25	12029	130.00	27430	39459	154447	
25	Magyi-ok	74.60	38717	63.25	22517	85.25	27877	89111	93.00	11997	127.00	10414	22411	111522	
26	Kaingkan	75.50	21367	70.00	13650	85.50	15305	50322	92.25	11900	128.00	11776	23676	73998	
27	Inbin	74.50	82397	68.50	52129	86.50	60291	194817	91.00	11739	126.75	41828	53567	248384	
28	Tawdan	77.50	55180	71.00	34790	86.25	38640	128610	90.50	11675	125.50	4644	16319	144929	
29	Nagabo	76.75	100466	75.50	67950	84.75	69919	238335	85.25	10997	120.00	17640	28637	266972	

No	Wards /Village Tracts	Monsoon Paddy						Summer Paddy						Year Round	
		Shebopawsan		Ayeyarmin		Shethweyin		Total Production	Shethweyin		Paletwe		Total Production	Total production	
		Yield/Acre	Production	Yield/Acre	Production	Yield/Acre	Production		Yield/Acre	Production	Yield/Acre	Production			
30	Htonbo	76.50	94248	75.25	63812	84.25	65378	223438	81.50	10514	121.75	28977	39491	262929	
31	Thabeikle	75.50	82522	73.50	55272	84.50	58221	196015	81.25	10481	123.50	15808	26289	222304	
32	Aeinya	75.75	46208	73.75	30901	82.50	31680	108789	82.25	10610	122.00	1098	11708	120497	
33	Minshwehnt	74.75	69592	73.00	46720	82.25	48199	164511	82.50	10643	119.75	37362	48005	212516	
34	Taukkashut	74.50	44775	72.00	29736	82.65	31324	105835	82.75	10675	118.00	17346	28021	133856	
35	Bagan	74.00	57498	72.50	38715	81.50	39854	136067	83.65	10791	115.75	15974	26765	162832	
36	Kyaket	73.50	61520	72.85	41962	81.75	43164	146646	84.50	10901	114.50	27251	38152	184798	
37	Saingpyin	73.00	104317	71.00	69793	81.90	73710	247820	84.25	10868	113.25	11438	22306	270126	
38	Mindekou	72.75	58346	70.25	38778	83.75	42294	139418	85.75	11062	117.75	11893	22955	162373	
39	Theinba	72.00	78624	69.15	52001	83.50	57448	188073	85.25	10997	116.50	30989	41986	230059	
40	Magyisauk	71.50	59274	68.25	38903	83.00	43326	141503	85.00	10965	116.00	8120	19085	160588	
41	Ayetharyar	70.00	83720	67.50	55485	71.75	54028	193233	80.00	10320	113.75	39699	50019	243252	
42	Lettee	69.75	52452	66.50	34381	71.50	33820	120653	80.25	10352	111.25	23919	34271	154924	
43	Yintway	69.50	35793	67.75	23984	71.25	23085	82862	72.25	9320	110.50	22321	31641	114503	
44	Waba	68.50	48704	66.25	32396	72.00	32256	113356	73.50	9482	108.75	23708	33190	146546	
45	Kyi	68.85	102242	64.75	66175	72.50	67788	236205	70.25	9062	104.50	42218	51280	287485	
46	Hsattpyakyin	67.70	61878	63.50	39942	72.75	41904	143724	71.00	9159	107.00	33384	42543	186267	
47	Choneywa	67.20	42874	62.25	27266	63.00	25326	95466	75.25	9707	105.75	12056	21763	117229	
48	Inboke	66.50	78537	64.50	52374	62.75	46686	177597	75.00	9675	103.00	35947	45622	223219	
49	Indainglay	66.00	75042	63.25	49525	61.50	44034	168601	74.00	9546	104.75	19798	29344	197945	
50	Paungtaungku	65.85	58277	62.50	38063	63.50	35370	131710	70.50	9095	103.75	20646	29741	161451	
51	Nagadwin	65.50	64976	61.75	42175	61.75	38594	145745	71.00	9159	102.00	26112	35271	181016	
52	Indainggyi	64.75	63196	61.50	41267	62.50	38438	142901	69.92	9020	102.50	8508	17528	160429	
53	Thayetkyin	64.00	32320	61.25	21254	63.75	20273	73847		0		0	0	73847	
54	Thitya-aike	63.50	31433	60.25	20485	63.50	19812	71730		0		0	0	71730	
55	Ingyinbin	62.75	27485	60.50	18271	62.75	17319	63075		0		0	0	63075	
56	Ingyinthapo	61.25	29461	60.75	20108	62.50	19000	68569		0		0	0	68569	
57	Hsattlu	60.50	35453	60.90	24421	63.00	23373	83247		0		0	0	83247	
58	Setaw	60.49	44581	60.87	30800	63.99	29755	105136	0.00	0	0.00	0	0	105136	
	Total		7184052		4634550	71.23	4660212	16478851	74.28	979804	105.80	2486612	2152750	11534718	

Source: Township Land Management and Registration Department, Tabayin.

In paddy cultivation, the largest sown acreage is occupied by Tetawvillage tract with 9,092 acres, the second largest by Mayakanvillage tract, with 8,082 acres, and the third largest by Thayetkanvillage tract with 7,925 acres. The other village tracts with more than 5,000 acres of paddy are Tetaw, Mayakan, Thayetkan, Hsutat, Tetkaung, Namyar, Namyar, Kyi, and Kundaung and those with 4000~5,000 paddy sown acres account for 6 village tracts namely Ayetharyar, Inboke, Nyaunghla, Inbin, Tane, and Htonbo. Between 3000 and 4000 acres under paddy cultivation occurs in 15 village tracts of Theinba, Ywashay, Saingpyin, Minshwehntit, Nagabo, Hsattpyakyin, Nagadwin, Indainglay, Tabayin (Town Proper), Mei-oh, Kyaket, Thabeikle, Taikywa, Paungtaungku, and Migyaungaing, the 2000~3000 paddy sown acres in 14 village tracts of Lette, Ohntabin, Waba, Htantabin, Indainggyi, Letyetkon, Bagan, Mindekon, Magyisauk, Yintway, Tawkyauung, Taukaashut, Choneywa, and Tawdan, and 1 the 1000~2000 paddy sown acres in 13 village tracts of Tawdan, Mukan, Setaw, Lethloke, Magyi-ok, Aeinya, Hsattlu, Thayetkyin, Kaingkan, Thitya-aike, Ingyinthapo, and Ingyinbin, and less than 1000 paddy sown acreage in 3 village tracts such as Pauktaw, Taungpyin, and Thayettaw.

Regarding per-acre yield, that of *Manawthukha* ranges from 88.44 baskets to 105.34 baskets in monsoon season and from 69.17 baskets to 126.96 baskets in summer while that of *Ayeyarmin* is from 88.69 baskets to 100.17 baskets in monsoon season. In paddy production, Tabayin Township produces more than 11,000,000 baskets a year and produced 11,534,718 baskets in 2016-2017. The largest production was in Tetawvillage tract with 525,914 baskets, the second largest in Mayakan village tract with 451,592 baskets, and the third largest in Thayetkanvillage tract with 446,340 baskets. Other each production of 200,000 ~ 400,000 baskets was found in 20 village tracts of Tetkaung, Hsutat, Daingnat, Namyar, Kundaung, Kyi, Tane, Saingpyin, Nagabo, Nyaunghla, Htonbo, Inbin, Ayetharyar, Ywashay, Tabayin (Town Proper), Theinba, Inboke, Thabeikle, Minshwehntit, and Mei-oh, that of 100,000~200,000 baskets in 26 village tracts such as Indainglay, Migyaungaing, Hsattpyakyin, Kyaket, Nagadwin, Taikywa, Ohntabin, Letyetkon, Bagan, Mindekon, Paungtaungku, Magyisauk, Indainggyi, Lette, Htantabin, Tawkyauung, Waba, Tawdan, Taukkashut, Mukan, Lethloke, Aeinya, Choneywa, Yintway, Magyi-ok, and Setaw, and that of less than 100,000 baskets in 9 village tracts such as Hsattlu, Kaingkan, Thayetkyin, Pauktaw, Thitya-aike, Ingyinthapo, Choneywa, Ingyinbin, and Thayettaw.

In this analysis, *the overlay method* is used with the help of GIS. The overlay map of spatial distribution of canals on the map of irrigation intensity by village tract is described in Figure 7. The overlay map clearly shows that irrigation intensity is high in the village tracts in Tetaw, Mayakan, Thayetkan, Hsutat, Tetkaung, Namyar, and Daingnat, Kyi, Kundaung, Ayetharyar concretely between Letyar and Mayakan Canals. Therefore, some irrigation intensities or paddy sown acres occur at or near the destinations of the irrigation canals. This fact indicates how much irrigation water is important in the study area.

In the study area, the relations between village tract wise paddy irrigation intensity and first paddy cultivated acres and then paddy production are analyzed, by using regression analysis as shown in Figure 8 and 9. In a township, paddy production relies on the extent of paddy cultivated acres because total paddy production mainly depends upon total sown acreage. With this consideration, these analyses are done. According to the analyses, it shows that paddy sown acres increase directly with the paddy irrigation intensity in Tabayin Township, i.e., the greater the paddy irrigation intensity, the larger the paddy sown acreage is. It is displayed by the regression equation $y = 14.052x - 1847$, the determinant $R^2 = 0.1576$ and the correlation coefficient $r = 0.4$. These indicate that there is a low degree of positive correlation between paddy irrigation intensity and paddy sown acreage.

In addition, in Figure 9, the regression equation $y = 741.1x - 19834$, the determinant $R^2 = 0.1406$ and the correlation coefficient $r = 0.38$ point out that there is also a low degree of

positive correlation between paddy irrigation intensity and paddy output (production) in Tabayin Township. It means the paddy output or paddy production also depends on paddy irrigation intensity, that is, the least the paddy irrigation intensity, the least the paddy production is.

Result and Discussion

The irrigation type of paddy production is canal irrigation in Tabayin Township. The research shows that paddy species commonly grown in the township are *Shwebopawsan*, *Ayeyarmin*, *Shwethweyin* and *Paletwe*. All of the species are cultivated with the help of irrigation by means of canals. According to the overlay map clearly shows that irrigation intensity is high in the village tracts in Tetaw, Mayakan, Thayetkan, Hsutat, Tetkaung, Namyar, Daingnat, Kyi, Kundaung, and Ayetharyar concretely between Letyar and Mayakan Canals. Accordingly, paddy is found to have been grown on nearly all of the sown acres of the above-mentioned village tracts. Regarding per-acre yield rates, it is found, in average, to be 77.39 baskets in Monsoon *Shwethweyin* and 84.64 baskets in Summer *Shwethweyin*. This shows that the yield of summer paddy is greater than that of Monsoon paddy. The regression analyses on the relationship between paddy irrigation intensity and first paddy cultivated acres shows a low degree of positive correlation. The relationship between paddy irrigation intensity and paddy output (production) reveals a low degree of positive correlation.

Conclusion

Tabayin Township has three canals namely Letyar, Ye-U and Mayakan canals. Finally, it can be concluded that irrigation work or canal irrigation can increase the paddy sown acres as well as yield per acre and also increase the paddy production. The notable one is another finding which shows that per acre-yield rate of summer paddy is significantly more than that of monsoon paddy in Tabayin Township. This research clearly shows that irrigation intensity increases the paddy sown acreage, the per-acre yield, and then production.

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References

1. Cantor, Leonard M, (1967): **A World Geography of Irrigation**, London, Oliver and Boyd, pp5, 4, 102
2. Gregor, Howard F., (1970): **Geography of Agriculture**, Themes in Research, London, Prentice-Hall Inc.,p-31
3. Hammond, R &McCullagh (1978): **Quantitative Techniques in Geography**, Second Edition, Clarendon Press, Oxford
4. Jasbir Singh (1974): **An Agricultural Atlas of India,A Geographical Analysis**, Kurukshetra, Vishal Publications, p1
5. Jasbir Singh & Dhillon, S S (2004): **Intensity of Irrigation, Agricultural Geography**, Tata McGraw-Hill Company Limited, New Delhi, p119~121
6. Symons, L., (1967): **Agricultural Geography**, London, G. Bell, pp-32, 46-49
7. Yeates, Maurice H. (1968): **An Introduction to Quantitative Analysis in Economic Geography**, New York, McGraw-Hill Book Company, pp.39-41

