

# AGRICULTURE AND HUMAN IMPACT ON ENVIRONMENT IN INDAW GYI AREA: CASE STUDY IN MOHNYIN TOWNSHIP, KACHIN STATE, MYANMAR

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## Abstract

*This study is agriculture and impact of socioeconomic activity on Indaw Gyi Lake, close to Hpakant jade mine is huge potential agricultural productive area and. Rain fed agriculture is important socio-economic sector and a variety of crops are grown. Cropping pattern and harvest depend upon topography and climate variation. Pasture management, indigenous crop varieties and agroforestry, socioeconomic activity, soil and environmental conservation surveyed are needed. Run-off and serious soil erosion resulting in Indaw Gyi Lake, strategies to establish ideas and eco-friendly farming in watershed area need to be surveyed. Impacts of human activities and innovation action plans are an important factor related to watershed protection issues. Sustainable management on agriculture is the basis for analysis and implementation of alternative eco-friendly and agroforestry development models in the study area. Soil erosion from gold mines is highly related activities. Logging is major challenges of the Indawgyi Lake. Increasing newcomers stand by fishing in Indaw Gyi Lake and jade mine related jobs need to be studied.*

**Keywords:** climate variation, cropping pattern, impacts of human activities, Indaw Gyi Lake, rain fed agriculture, run-off and serious soil erosion, watershed protection.

**Aim and Objectives:** This paper is focus on current situation of agricultural practice and environmental issue in Indaw Gyi area, Mohnyin Township,. Food security, socioeconomic development and environmental sustainability of Indaw Gyi Lake by means of eco-friendly crops production is major aim of the study.

**Objectives:** - to study current situation of agricultural activity, variation climate, to analyze market potential agricultural practice and crop pattern, to observe impact economic activity on Indaw Gyi Lake, to discuss comprehensive way of agricultural landscape.

## 1. Introduction

This study is agriculture production, market potential and impact of socioeconomic activity on Indaw Gyi Lake in Mohnyin Township, Kachin State. It is situated on the way to Hpakant jade mine, potential agricultural productive area. Total population was 183,682 in 2016. It is composed of (29) village tracts, 105 villages and

5 quarters. Rain fed agriculture by means of utilization of animal power and small scale machinery and production is mainly for local consumption and for local markets in Kachin State. Agriculture is important socio-economic sector in Mohnyin Township and a variety of crops are grown. Its cropping pattern reflects in variation climate and topography. The main crops are rice. Cereals, oil seeds and pulses variety are grown in all parts of the area.

**2. Literature Review:** Literature review is carried out before field work in Mohnyin area. Review studies related to the agriculture, land use, crop cultivated patterns and crop combination, agricultural productivity and development, planning and physical constraint, soil classification. Agricultural geography covers a large segment of economic geography and environmental aspects are emphasized.

**3. Materials and methodology:** The qualitative and descriptive research technique is used. Official data and intensive field works were organized in May 2016-17. During the field work, informal interviews and discussion with the authority persons in Mohnyin Township and personal observation were undertaken. Source of official data are obtained from Immigration Department, Agriculture Department, and Meteorology Department in Mohnyin.

Based maps: One inches scale topographic maps (1942)-92 C/SW and Google earth maps are used.

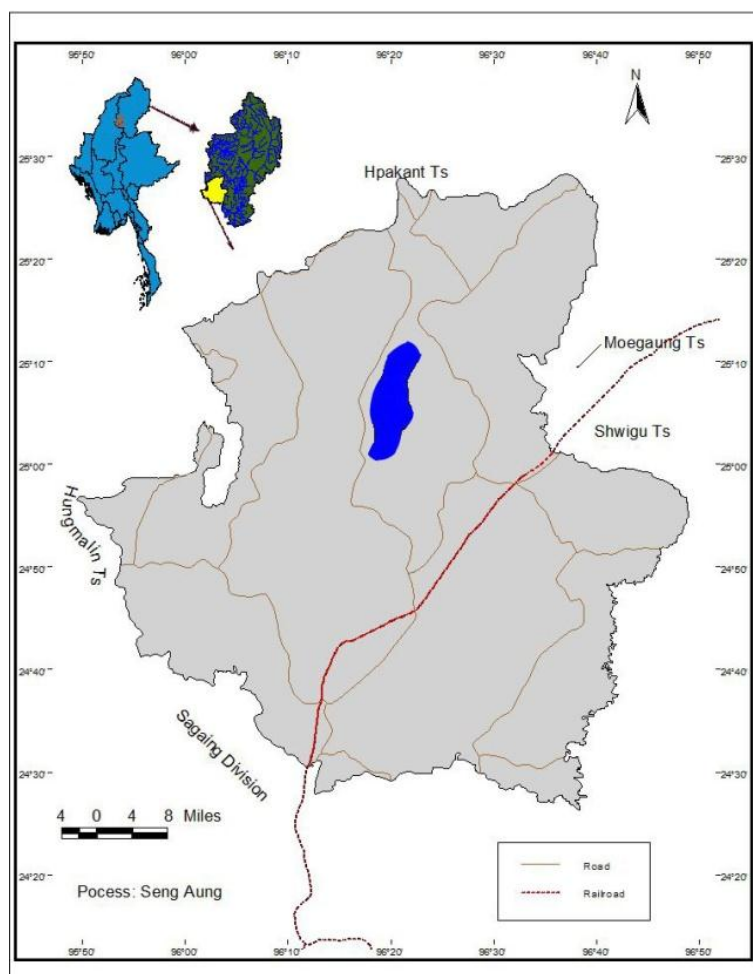
The structure of field work was designed by GIS technique to produce maps and figures.

**4. The result: Result** would be advantaged for teaching and research in agricultural geography and economic geography as environmental issues, contributing local and regional sustainable development toward sustainable local socioeconomic development function and environmental sustainability in Indaw Gyi Lake environment.

## **5. Geographic landscape**

### **5.1 Location:**

Mohnyin Township is situated in the western part of the Kachin State, and which lies between latitude of 24° 30' 46" N - 25° 26' 59"N and longitude of 96° 02' 12" - 96° 46' 03" E. It's an area of 2578.51 square miles (1,650,240 acres), wide valley plains and surrounded by mountain ranges. It is bordered with Mogaung and Shwigu on the east, Sagaing Division and Hungmalin Township on the west, Hpakant Township on the north. Mohnyin Township is mountainous area and mountains are running from north to south. The total length of north to south is over 50 miles and east to west is over 40 miles. Topographically, it is located at 685 feet height above sea level. The highest range is Wa Baw mountain ranges and surrounded by Gantgaw mountain ranges on the east, Yankin mountain ranges on the south.



**Figure (1): Location Map of Mohnyin Township**  
Process: Seng Aung (2008)

### ***5.2 Drainage:***

Namyin chaung (40 miles long) is major stream and it takes its source near Semaile Ywathit and it is drained from south to north along middle part of Mohnyin and enters into Mogaung chaung. Indawgyi Lake, the largest lake in Myanmar, also in ASEAN, flows from south to north and enters into Mogaung chaung. It is 14 miles long from north to south and 7 miles wide from east to west. The villages are situated around the lake and people living in the villages around the lake use the boats as important transport and communication.

### ***5.3 Vegetation:***

There is different vegetation types can be observed in study area. Evergreen and deciduous forests types can be studied, teak is popular in Mohnyin Township area.

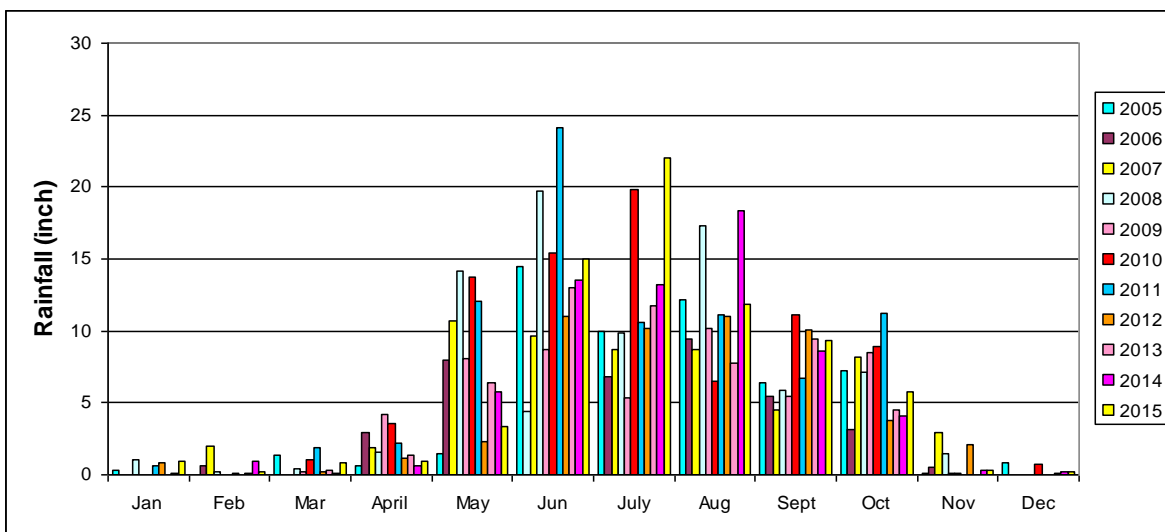
**Soils:** The influence of climate, natural vegetation and organisms gives rise to the formation of different soil types. Alluvial soils are found along the Namkaung creek and Namyin creek valley sides, make up of rivers, streams, and their tributaries.

The soils can be divided into 4 groups. Meadow soils are found on flat plain along the Namkaung and Namyin valleys. Meadow's yellow brown forest soils occur on higher

ground and occupy the eastern and western parts of the study area. The thickness of the soil ranges from 2 to 3 inches. It is thinner on steep slopes and thicker in gentle slopes. Sugar-cane and cereals and oil crops are growing on such soil. Mountainous yellow brown forest soil is formed under the deciduous forests and on the well-drainage slopes. It covers 1/4 of the township area. On the gentle slopes, it is about 40 inches while on steep slope. Red brown forest and yellow brown forest soil is found on places above 500 feet where the average rainfall is more than 120 inches, especially in the northern part of the township.

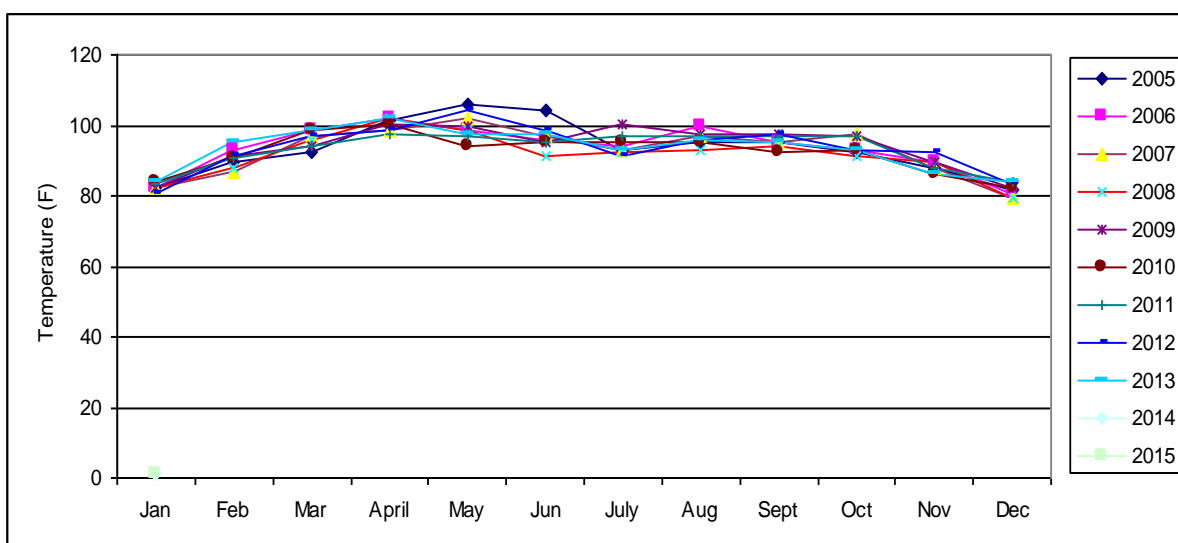
**5.4 Climate:**

Tropical monsoon climate can be experienced in Mohnyin Township and maximum temperature is 38.3 °C and minimum temperature is 4.5°C. Yearly and monthly rainfall and Maximum temperature can be described in Figures.



**Figure (2): Rain fall of Mohnyin Township**

Source: Meteorological Department, Mohnyin, Kachin State



**Figure (3): Maximum Temperature of Mohnyin Township**

Source: Meteorological Department, Mohnyin, Kachin State

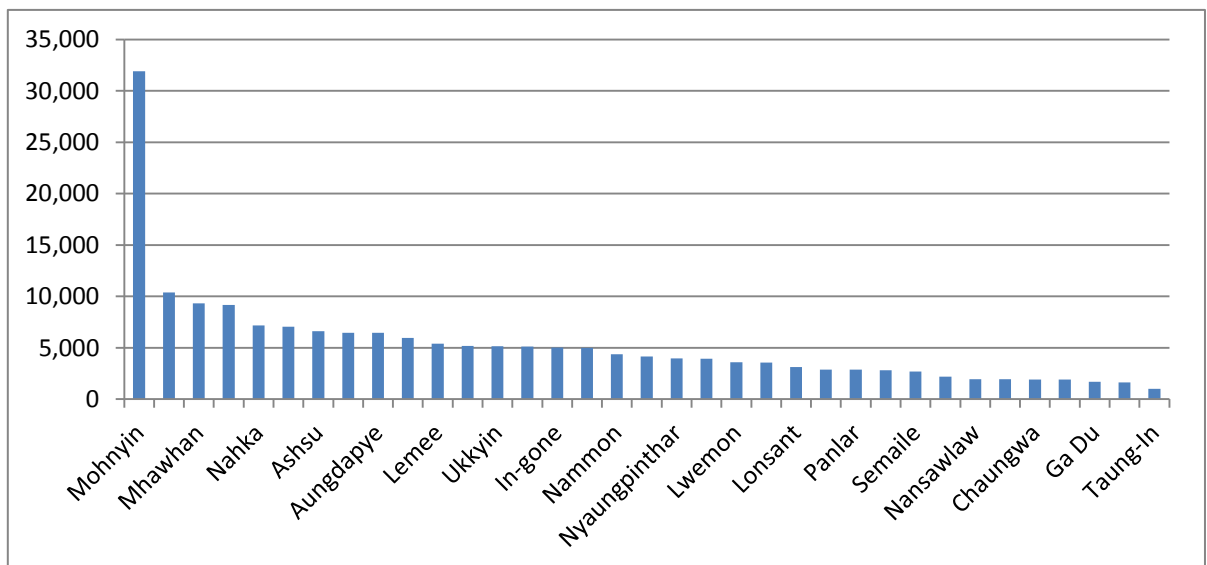
### 5.5 Geology:

In general, the major stratigraphic rock units exposed in this township range in age from Precambrian, low grade metamorphic, Precambrian rocks, Cretaceous rocks, Miocene units, Ayeyawady Formation rock units, alluviums and igneous rocks. The major faults frequently occurred in NE-SW directions. Low grade metamorphic rock units are exposed at Nanpanbum and other mountain ranges in the west of Indaw Gyi Lake, where they are associated with basic and ultra basic igneous rocks. These igneous rocks are composed of granite and other non basic rocks in the west of Mawhan, gabbros and related intrusive rocks in the west and northwest of IndawGyi Lake and ultra basic rocks in the western portion of the Namyin hka reserved forest area. The volcanic rocks are the eastern continuation of Taungthonlon volcano and are found in the western most part of Mohnyin Township.

### 5.6 Population distribution:

Population distribution can be studied by villages, by village tracts, and by wards in Mohnyin. The largest population number can be analysed in Nahka ward, the second in Ashesuyat ward, the third in Myoma ward, the fourth Aungdapye ward and the fifth in Ukkyin ward. Total population only in Mohnyin Myo is 31890 inhabitants.

According to data obtain from “Population Section of Land use Department in Mohnyin Myo”, total population of the whole Mohnyin Township is 203, 523 in 2016. Population distribution in Mohnyin Township can be classified and village distribution is related to topographic conditions. Suitable sites for cultivation, good transportation, are closely related to local people settle down permanently. The lowest population density in Panlar, and population density is 1.3 in Ga Du. The highest population density (18,485 per sq. mile) is in Mohnyin Myo area. This area is socioeconomic boom center such as education, health care, market, road and communication.



**Figure (4): Village Tract-wise population distribution in Mohnyin Township (2016).**

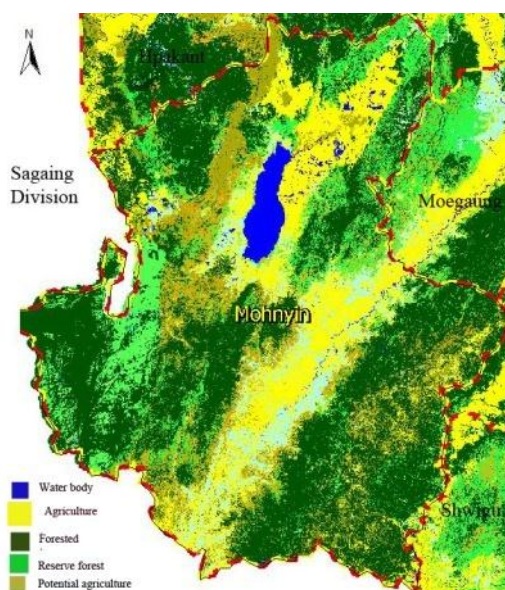
Source: Land use Department in Mohnyin Myo.

### 5.7 Communication:

According to field study, tar road and gravel road can be seen in Mohnyin Township area. Rail road is main transportation for cheaply commodity flow. A motor road from Myitkyina to Mandalay through many villages and it can be used all seasons. Rail road between Myitkyina and Mandalay is good transportation from Mohnyin to other parts. Raw materials and goods are carried by rail road.

### 6. Agricultural potential and economic activity

There are four categories of land cover: (1) Natural forested are (598,865 acres), (2) Reserve forest (496,810), (3) Agriculture land (138,142), (4) Potential agriculture land (315,762), and (5) Other land (109,402).



**Figure (5): Land cover (2016)**

Source: Seng Aung, (2015)

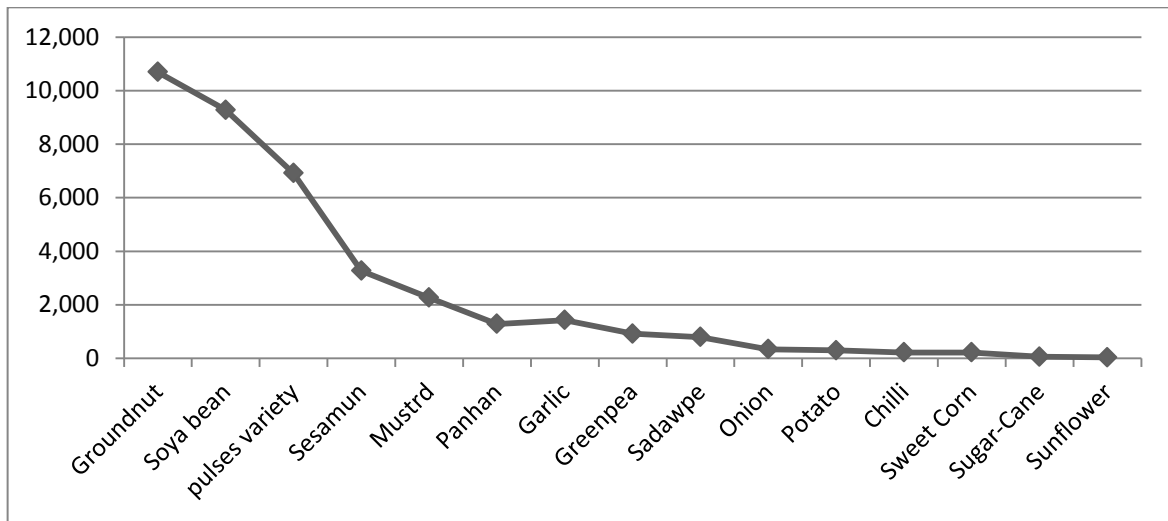
The Potential agriculture land of Mohnyin Township was 315,762 acres. Agriculture land is classified into (6) categories include 1) wet rice field/Le (104,411 acres), 2) dry cultivation field/Ya (5,098 acres), 3) flood plain cultivated field/ Kaing / Kyun (1,129 acres), 4) Garden (9,963 acres), 5) shifting taungya (75 acres) and 6) Fallow land.

The local people establish wet rice cultivation of rain fed agriculture adapted to local climate where area is wide valley plains with good soil increase nutrients from resulting alluvial soil and enhance crop growth.

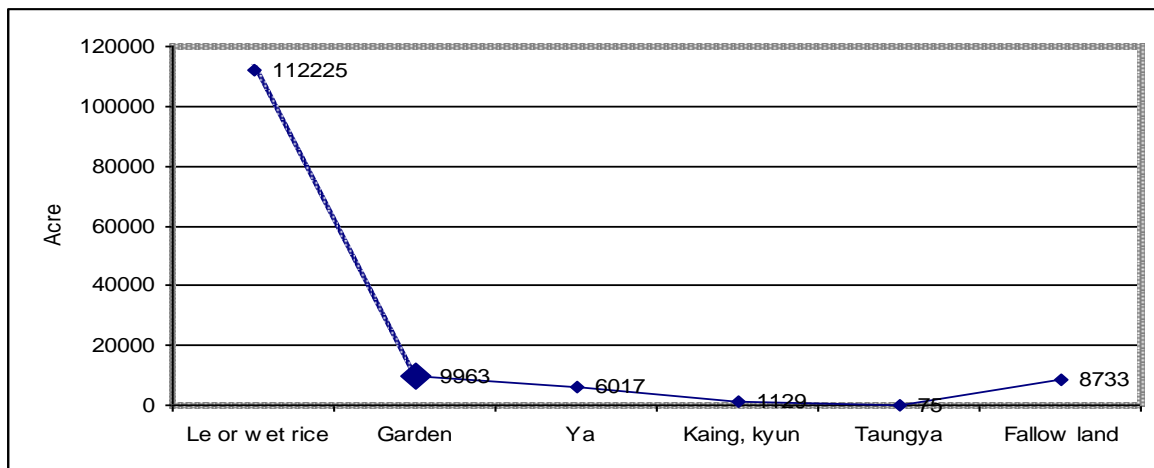
#### 6.1 Agricultural Patterns:

The physical feature and climatic conditions enhance the agriculture patterns in Mohnyin Township. The cultivated crops are rice, oil crops, pulses, cereals and other vegetables. The area of rice cultivated area is the highest amount (112,225 acres).

**Type of Agriculture:** Rice cultivated area (107655) acres, mustard (1159), beans (1301) and corn (229) in 2015-16. Taungya cultivation can be studied very small scale.



**Figure (6): Winter crop varieties cultivated acres.**

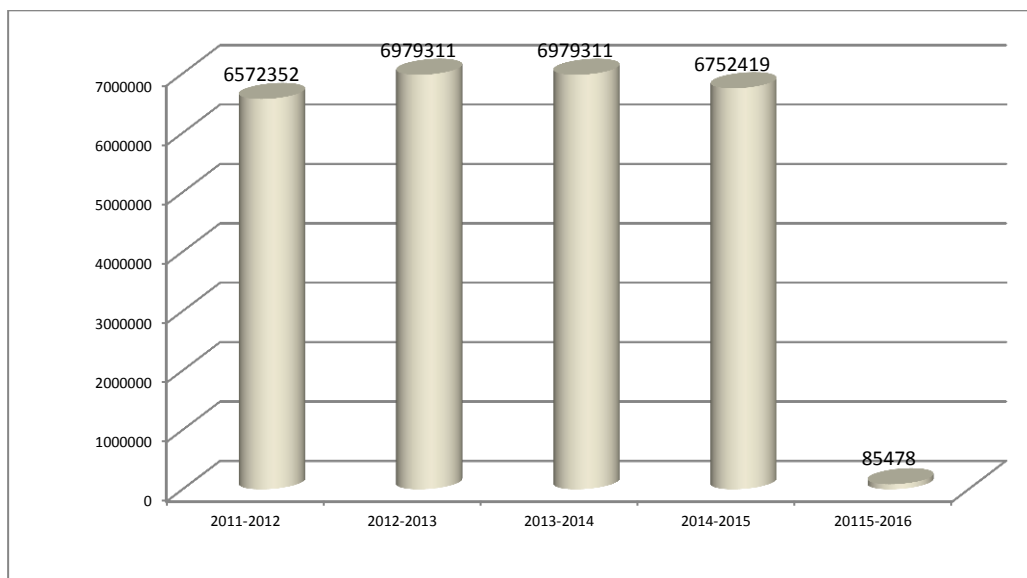


**Figure (7): Types of agriculture in Mohnyin Township**

Source: Data obtained from Land use Department in Mohnyin Township (2016).

**Le land:** Le or wet rice cultivation is the largest agriculture practice and total Le land is (112,225) acre, Ya or dry cultivation/ oil seed cultivated land is (9,963) acres, garden land is (6,017) acres, flood plain cultivated land is (1,420) acres, shifting is 75 acres and fallow land is (8733) acres in 2016. The Le land can be found along the streams where the alluvial soil is deposited and in the low land area which reserved the rain during the rainy seasons. Rice is main agricultural crop and groundnut, beans and other seasonal vegetables are grown after harvest rice (November- April). The groundnut is grown in winter and harvest in summer. During the groundnut growing period, other pulses and kitchen crops are also grown on Le-land together with the groundnut. Bean is grown as market scale in some villages. Rice is grown during July and August, and harvest in November to December.

Yearly rice production (in baskets) in Mohnyin Township is described as Figure. Total rice production in 2015-16 was decreased due to flood damage crops in the whole Myanmar.



**Figure (8): Rice production (in baskets) in Mohnyin Township**

Sources: Data obtain from Land use department in Mohnyin Township (2016)

The largest cultivated areas of rice are Nanmon, Lone Sant and Chaungwa village tracts, around Indaw Gyi Lake, and soil fertility is suitable for rice and seasonal crops production. These areas are located on the way to Hpakant and rice and agriculture products are transported to jade mine market places and gold mine areas around Indaw Gyi area. These areas are located in the northern part of watershed areas of Indawgyi Lake. Around Indaw Gyi Lake, there are (6500) acres in Lonesant, (5616) acres in Hepu, (5318) acres in Nammon, and (5318) acres in Chaungwa village tracts respectively. The second largest rice cultivated area can be found in Balu, Lemee, Inngone, Mamonkai, Kyargyigwin and Myothitkalay. These areas are huge valley plain in central part of Mohnyin Township and Namyin stream and other small streams flow through in these areas. This situation encourages the agriculture, especially the rice cultivation. The lowest rice cultivated areas can be found in the mountainous region and Mohnyin Myo area. In these areas, the rice land was less than 1,000 acres.

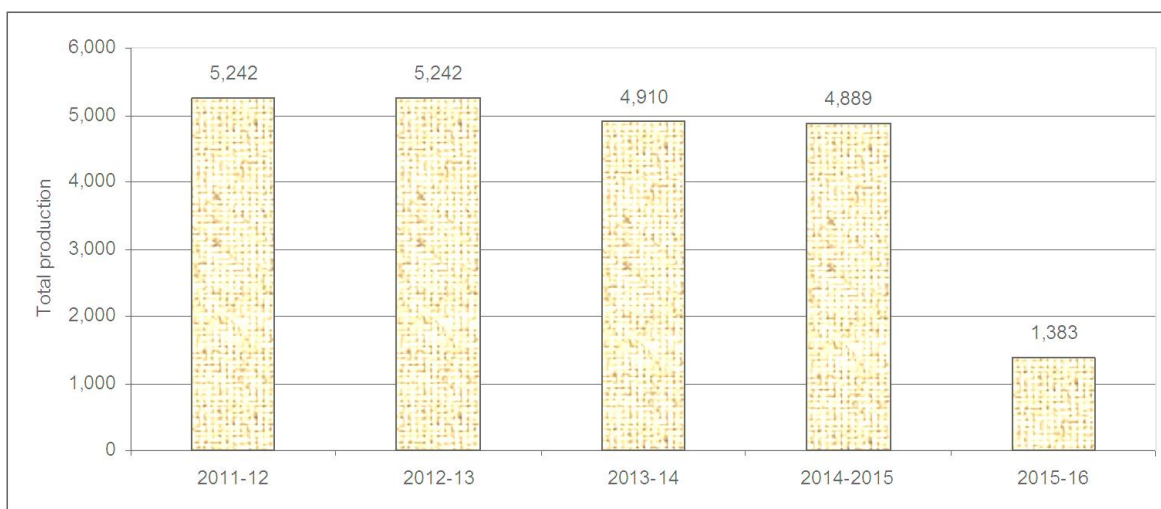
Agricultural cultivated area is gradually decreased because farmers' interested in other quick earning jobs such as working in gold mine, jade mine and amber extraction areas (Tharmahkan, Karmine, Indaw Gyi, Hpankant, and Tanai/ Hukawng Valley). Farmer face difficulties to get good quality seeds, fertilizer, pesticides, land tenure, limited finance, high transport costs, weakness of technology and access to markets. They have insufficient access to agricultural practice. These difficulties are pushing local farmers to go to mining areas for the purpose of working in companies which are large scale mechanical investment in gold and jade mine areas, some are cycle carry and odd job worker, etc. for their earning. There are many social and diseases problems such as malaria, dengue hemorrhagic fever, cholera, and young man mine erosion and drug are common in gold and jade mines. So local farmers go back home due to they are facing difficulties for earning in mining areas and go back home to practice agriculture again. This situation cause increase agricultural production.



Percentage of total Agriculture area is 8.33% and total rice cultivated area is (61.553) percent of the total land cover area in Mohnyin Township. It also has the highest percentage of sown acreage than the other crops lands.

**Ya Land:**Total Ya Lands in study area occupy the drier land and is the second largest area of agriculture land and it covered about (6,017) acres. It is usually found at the foot hill and upland area. Study area is mountainous and the Ya can be observed along hill slopes and small valley plains in riversides. Crops mostly grown in Ya lands are sesame and monsoon groundnut. These are grown in rainy season (Jun-July) and harvest in winter (November- December). The sesame and other pulses are grown on Ya land and harvest in hot season (April- May). Crops grow on Ya Lands are sugar-cane, dry rice, beans, sesame, maize, mustard, potatoes, and vegetables.

Maize is grown to get corn-cobs seeds for home consumption. The average maize cultivated area from 2011-12 to 2015-16 was (1,958) acres. The highest maize grown acreages was (96) acres in 2011-12, (96) acreages in 2012-13, and the least acreage was (90) acres in 2014, 2015, and in 2016. The average annual matures acreages of maize was (211) acres. Total production was (4333.2) basket. Maize is grown during May and harvest in August.



**Figure (9): Yearly maize production in Mohnyin Township**

Source: Data obtained from Land use Department, Mohnyin Township

Mustard is grown mainly to produce oil. During the 5 years (2011-16), the average of mustard was (2,722.8) acres. The average yield is (11.25) baskets per acre, and the maximum yield is (11.30) baskets per acreages. The annual average production of mustard is (25,526.2) baskets. Mustard is grown on old matured Kaing lands/ flood plains and alluviums soil during September - October and harvest in February - March.

During the 5 years period from 2011-16, the average annual cultivated acreage of sesame was (3,129.2) acres. The annual average yield is (53.05) baskets per acre, and the maximum yield of (12.07) baskets per acre. The annual average production of sesame is **(39,057.6)** baskets. The sesame is grown in September and harvested in December - January.

Panhan, oil seed crops is chiefly grown in Mohnyin Township.

The average annual sown acreage in Mohnyin Township, during the 5 years period, from 2011-12 to 2015-16 was (1,290) acres. The highest sown acreage was (161,290) acres in 2015. The annual average yield per acre was (8.27) baskets and the average of the total production was (10,668.6) baskets.

During the 5 years period from 2011-12 to 2015-16, the average sown acreage of sugar cane was (64) acres in 2011-12, and the least was (20) acres in 2015-16. The sugar cane cultivation is substituted by other potential cash crops due to no sugar mill.

Varieties of pulses such as green bean, soya bean, Green gram, pigeon pea, and pedesein are chiefly grown in Mohnyin Township. Green bean is the most important cash crop.

In Mohnyin Township, during the 5 years period from 2011-12 to 2015-16, the average sown acreage of Soya bean was (6,463) acres. The yield per acre was (19.934) baskets. It is grown during May to June, and harvest during in September and October. The sown acreage of other pulses, such as Matpe, Pedesein, amounted to only acres. They are also grown in Namyin - Namkaung chaung valley plain.

Vegetables are the most important seasonal cash crops in this township and are grown during the rainy and winter seasons. Potato, tomatoes, rozelle, cabbage, cauliflower, pumpkin, gourd, ripped gourd, cucumber, brinjal, bitter gourd, and coriander are chiefly grown. The land cultivated by vegetables is (474) acres in Mohnyin Township. They are grown nearly in every village tracts on subsistence basis but the surplus is sold in local markets is family household income generation.

Among the vegetables, the potatoes are the most important crop in Mohnyin Township. It is grown during September and October, and harvest in February. The average sown acreage of potatoes was (27) acres. In 2015-16, the sown acreage was (61) acres, and the yield per acre was (1,650) viss. Mohnyin Township is the chief potato growing areas. Among other crops, fruit is economic importance in Mohnyin Township. In 2015-16, the sown acreage of fruit was (360) acres. The important fruits grown in this township are dog fruit, lichi, oranges, mangoes, citrus fruit and pine apples, and are mostly grown in the orchards and in the gardens of private compounds.

**Table (1): Yearly crop sown acres in Mohnyin Township**

Year	Rice	Soya bean	Green pea	Sesamun	Sunflower	Panhan	Maize
2011-2012	82,930	9275	795	3,274	2011-12	1,290	96
2012-2013	81,958	8940	802	3,344	2012-13	1,290	96
2013-2014	82,633	8940	802	3,006	2013-14	1,290	90
2014-2015	84,566	2580	762	3,006	2014-15	1,290	90
2015-2016	85,029	2580	762	3,016	2015-16	1,290	90
Average	83.4232	6,463	784.6	3,129.20	Average	1,290	92.4

Sources: Land Records office, Mohnyin Township

**Table (2): Crops cultivation in 2011-12**

Crops Name	Cultivated acres	Yield per acre (Basket)	Total Production
Groundnut	10,696	50.64	5458050
Soya bean	9275	20.15	186891
Pulses variety	6915	19	131385
Sesamun	3274	10.5	34380
Mustrd	2269	11.2	25413
Panhan	1290	8.25	10643
Garlic	1428	1535	219792
Greenpea	924	10.7	9887
Sadawpe	795	10.35	8228
Onion	344	2579	887176
Potato	301	2941	-
Chilli	226	476	107576
Sweet Corn	225	24258	5458050
Sugar-Cane	64	24.24	1551
Sunflower	38	21.4	813

Sources: Land Records office, Mohnyin Township

**Table (3): Yearly agricultural crop production in Mohnyin Township.**

Year	Rice	Soya bean	Greenpea	Sesamun	Sunflower	Panhan	Maize
2011-2012	6,572,352	186891	8228	34,380	813	10,643	5,242
2012-2013	6,539,003	177727	8260	36,230	278	10,643	5,242
2013-2014	6,979,311	177727	8260	36,270	278	10,643	4,910
2014-2015	6,752,419	51290	273	31,733	31,733	10,707	4,889
2015-2016	85,478	51290	273	6,675	6,675	10,707	1,383
Average	5,385,712.60	128,985	5,058.80	390,057.60	7,955.40	10668.6	4333.2

Sources: Land Records office, Mohnyin Township

**Flood plain/ Kaing, kyun Land:** Total area of Kaing - kyun is (1,129) acres. Kitchen crops such as seasonal vegetables are mostly grown in the Kaing- kyun land. Cabbage, cauliflower, pumpkin, gourd, ripped gourd, cucumber, brinjal, bitter gourd, garlic, onion, ginger, chilly, carrot, beans, watermelon, and coriander are grown as market purpose.

**Garden Land:** The total garden lands occupied only (9,963) acres of Mohnyin Township. The garden lands include commercial orchards. In orchard lands, dog fruits, oranges, mangoes, citrus fruits (such as lemon) are grown and star apple, coffee, flowers and vegetables are grown in home garden lands.

**Taungya Land:** The total taungya lands are (75) acres. The taungya land can be found on the mountain slope and hill sides and rice or upland rice, maize (corn), sesamum, pulses and vegetables are grown. “Taunhya” cultivation or shifting cultivation is carried on during April-May and harvest in July-August.

**Fallow land:** The fallow land was (8,733) acres and it is greater than taungya.

**Labor force:** All the villagers, both men and women take part in cultivation and harvesting but it is especially carried out by women. They help one another; it is a joyous occasion where cultivation knowledge and experience is freely exchanged with one another. Rice sowing is also a collective work of the villagers and workers by money.

**Agriculture crops:** According to official classification on agricultural sector (State Administrative Department, Mohnyin), there are (7) classes can be studied as the following:

- a) Major crops include (10) varieties such as rice, maize, cotton, sesamum and groundnut, sugar-cane, soyabeans, sunflower, mustard, green bean, green gram, and etc.
- b) Long-term plantation include rubber, tea, betel-nut, coconut, c) Other cash crops: ginger, total cultivated area is (216) acres, total yield is (17,250) baskets.
- d) Utilization of machinery and e) Utilization of animal power: total animal of (31,531) heads of buffaloes and (66,899) heads of cows are using for agriculture.
- f) Local food and oil sufficiency.

The government has an agriculture planning to ward food and oil sufficiency of local people in Mohnyin Township. A long-term plan of cultivation is a sign of change to permanent agriculture. After reaping the rice, it is followed with cash crops like rubber, teak and etc. This permanent orientation is technologically feasibility, economically profitability, and environmentally sustainability.

Natural forest, soil, water play a key role in the livelihood of people.

**Table (4): Local food sufficiency in Mohnyin Township.**

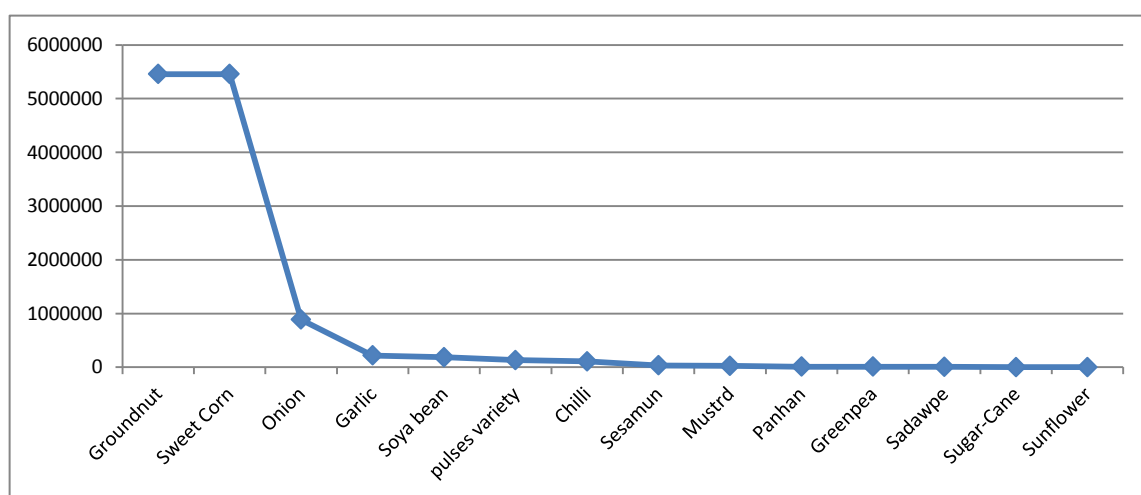
S. No	Variety	Year (2014-15)	Year (2015-16)	Progress
1	Population	200,314	203,606	3,065
	a) Urban residents	53,828	54,372	544
	b) Rural residents	146,486	149,007	2,521
2	Food need in basket	2,843,226	2,887,569	44,343
3	Cultivated acre of rice	108,718	109,484	766
	-Yield per acre in basket	79.45	79.52	0.07
	-Total yield in basket	8,637,299	8,706,146	68,847
4	Reserve in basket	543,590	54,7420	3,830
5	Used in basket	3,386,816	343,4989	48,173
6	Surplus/ need in basket	5250,483	527,1157	20,674
7	Food need in basket	4,706,893	4,723,737	1,6844
	Percentage of sufficient	255.02	253.45%	

Source: Government Office, Mohnyin Township (2016)

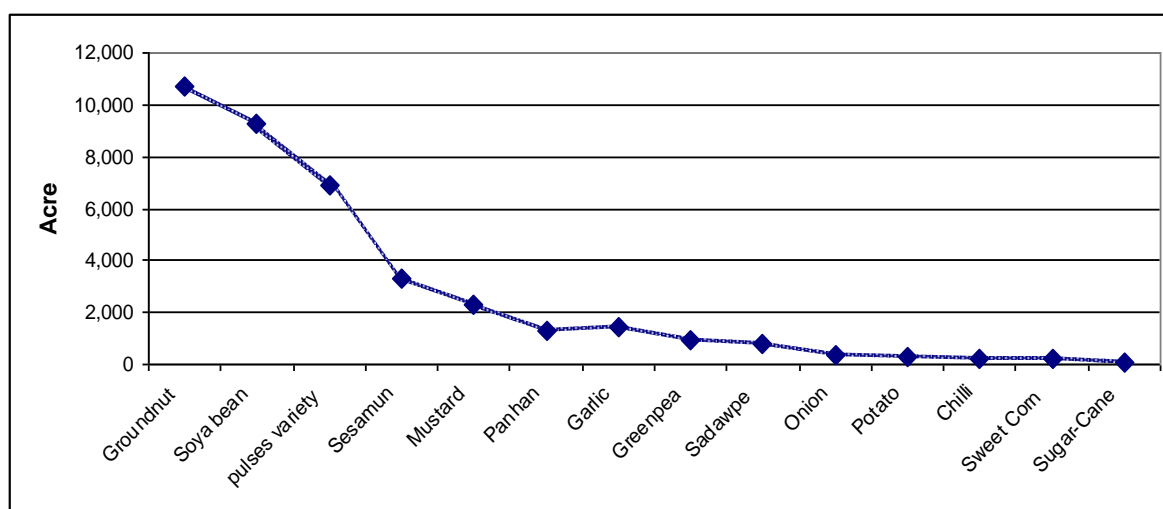
**Table (4): Local oil sufficiency (2014-16) in Mohnyin Township.**

S. No	Particular	Quantity	2014-15	2015-16	Progress
1	Population	Person	200314	203606	3065
2	Per consumption	Viss	6	6	-
3	Consumption need	Metric ton	2049	2255	206
4	Oil yield	Basket	2926	1761	(-)1165
5	Waste	Basket	53913.07	27782.40	(-)26130.67
6	Reserve in basket	Basket	31560.63	77171.25	45610.62
7	Usage	Metric ton	989	348	641
8	Surplus / need	Metric ton	(-)877	470	(-)406
9	Sufficiency	Percentage	149.02%	88.34%	

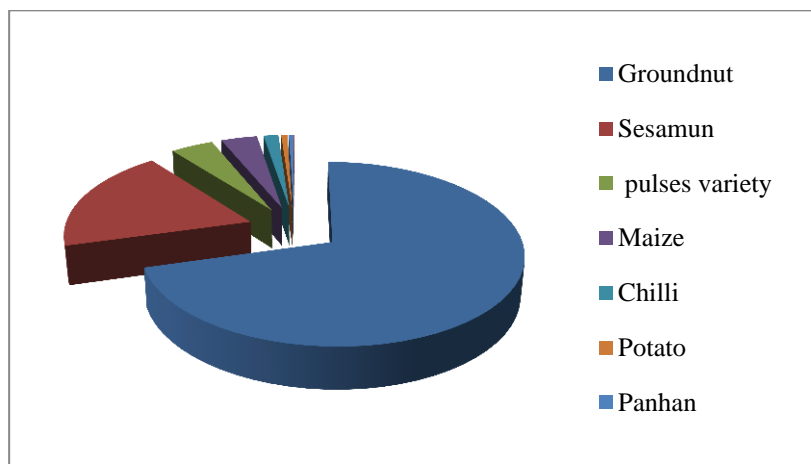
Source: Service Office, Mohnyin Township (2016)



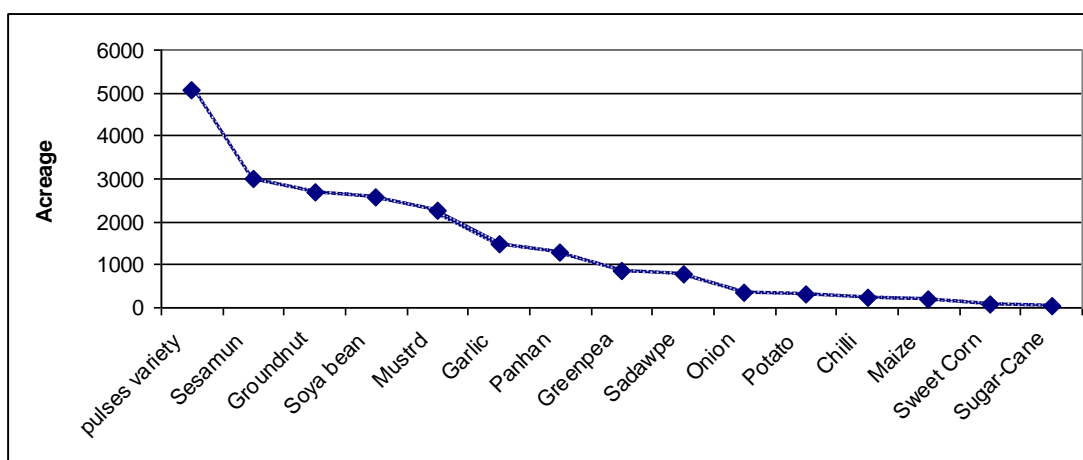
**Figure (10) : Crops production of Mohnyin Township (2011-12)**



**Figure (11): Crops cultivated acreage of Mohnyin Township**



**Figure (12): Crops production of Mohnyin Township (2015-16)**



**Figure (13): Crops cultivated areas in Mohnyin Township.(2015-16)**

Source: Agriculture Department of Mohnyin Township

## 7. Evaluation and Conclusion

### 7.1 Evaluation on agriculture:

It is rain feed agriculture practices. Decrease agriculture practice because farmers are facing difficulties to increase agricultural production benefits such as poor infrastructure, poor machineries and technical skill to operate agriculture, not enough financial support to buy good quality seeds, lacking irrigation facility and lack processing technology and to save from disease, flood damage, limited investment in farming are major source of leaving farms. Pull factor of people are working in jade mine, Hpankant, amber searching in Hukawng Valley for quick earning.

Agricultural potential are abundant water resources, natural pasture to raise livestock to obtain family diet (meat, eggs, and milk) and household income from farm products, wider alluvial plains, and aquatic fishing grounds and etc.

- Deeply identification on agricultural sector such as indigenous agricultural knowledge, techniques and resource utilization need to be carried out.

- Insufficient amount of application and labor, limited financial credits are major constrain of agriculture practice of farmers. Machinery agriculture transformation from rain fed system would be appropriate to promote agriculture in Mohnyin Township area. The people understanding on sustainable management on all types of agriculture and agricultural research will be bringing into sustainable goal.

- Farmers need training to manage commercial scale production of rice and other crops, (coffee, and agricultural related commodities like seasonal vegetables) due to they have close markets in mining areas.

- The people need to understand how to manage farming which is an important issue, because people mostly lack interested in agriculture. Much interest is needed to establish ideas for sustainable farming to change easily the people's desire for eco-friendly agriculture, nutrition, and security of land degradation. Extension field to produce oil crops, root crops, cereals and encouragement and preservation of agrobiodiversity in rain fed agriculture areas is needed.

- Need active participation and cooperation in farming activities and research to indentify both challenges and opportunities for sustainable agriculture and sustainability of IndawGyi Lake.

- Groundwater monitoring and arsenic measurement research and effective integrated planning and systematic irrigated farming are needed.

- According to observation people mostly in rural villages are working in jade mine and gold mines.

Potential agricultural area is high productivity due to physical feature; climate and soil fertility is appropriated.

The technical knowledge improvement of local people and the strength of eco-friendly farming and sustainable watershed management in IndawGyi area are needed. Proposal for sustainable management on agriculture development must take into consideration the need to promote sustainable land use. Sustainability is the basis for implementation of alternative agriculture and eco-friendly agroforestry models. Indigenous varieties of rice, crops and plants, will certainly contribute to a long cycle crop varieties with high levels of sustainability due to local climatic adaptation.

There are many possible models of eco-friendly agriculture and agro forestry systems resulting from combination of agricultural practice such as Le/wet rice varieties, Ya crops, and the taungya crops cultivation including seasonal, perennial and raising animals in various arrangements that offers foods and economic security for local farmers who produce them. Farmers have been substituting variety of fruit trees annual crops (taro, maize, chilli, pumpkin, mustard, buckwheat, potato, yam, beans, cotton and vegetables); perennial crops such as papaya, banana, tea, coffee, etc. These models are typical eco-friendly agriculture systems with reasonable levels of sustainability.

Research efforts for developing sustainable agriculture should be concentrated on good economic value and comparative local advantages for the development and maintained of integrated eco-friendly farming system.

Crop variety and local adapted animals show potential for development and will certainly contribute to sustainable agriculture. Development of sustainable agriculture will represent a feasible alternative to create new jobs, keeping labour, and agricultural products, increasing household income, decreasing social tensions and generating and incorporating technical knowledge towards environmental conservation or preservation of natural ecosystems in IndawGyi Lake area. The growing rice and agriculture crops are Hpakant, Myitkhina, Tanai, market potential.

### ***7.2 Impact on IndawGyi Lake:***

A major problem in the watershed of Indaw Gyi Lake is mainly soil erosion because the people cleared the forest for gold mining activities. Increase new comer population in IndawGyi area to search odd job and fishing for market purpose in mining area is needed to be considered. They stand mainly by fishing in Indaw Gyi Lake and by jade mine related worker. The impacts of human activities cause environmental risk. Research and innovation action plans is essential to support the implementation of appropriate land use systems responses to deforestation. Sustainable management on agriculture is an important factor related to watershed protection issues in Lake Area.

The local people should engage promotion of traditional forest reserves and the preservation of natural ecosystems for the present and future forest supply. The increase of agroforestry with innovative techniques and cooperative market systems will help of the success towards sustainability.

Soil erosion occurs from gold mines in western side of the lake throughout the village tracts. Its most serious consequence is a shallower the lake. Adequate attention to agricultural and environmental functions, such as research, training, information exchange, and local people participation and cooperation are highly interrelated activities and should be developed at different sectors. Logging and gold extraction is major challenges of the IndawGyi Lake because rapid run-off, serious erosion and deposition occur in IndawGyi Lake. The people need to understand how to manage agriculture and green, clean of the Lake environment is an important for socioeconomic and sustainable development.

### ***7.3 Conclusion***

Mohnyin Township is the southern part of Kachin State, northern Myanmar. Mandalay and Myitkyina Motor highway and rail way pass through the Mohnyin Township. This township is largest size in Kachin state and it has an area of 2,578.51 square miles (1,650,240 acres). The two mountains lie in parallel from north to south. The alluvial plain area can be found in northern and central parts of township which are important for agriculture.

Indaw Gyi Lake, the largest lake in Myanmar is situated in Mohnyin Township and flows from south to north and enters into Mogaung chaung in Mogaung Township. Lake water is not used for agriculture, but it is used for major fishing area.

Mohnyin Township is one of the most populated townships in the Kachin State. There is great difference in the density of population in each village tracts. In some village



tracts, the density is over, 1,000 persons per sq. mile, but in some village tracts, less than 100 persons per sq. mile. The main occupation is agricultural, animal husbandry and forest workers, fishermen and hunters.

Seasonal vegetables (potatoes, cabbage, cauliflower, pumpkin, gourd, etc.) are important cash-crop in Mohnyin Township. Rail road and motor routes are important for economic activities and infrastructure is better than before. Mohnyin Township is fairly well served with road and railway transpiration. Mohnyin - Mandalay road and rail road, Mohnyin - Myitkyina, Mohnyin -Tanai, Mohnyin-Phakant and Mohnyin- Thamakant road are significant in Township. Agricultural products and animals are exported to China as commercial scale that is carrying by brokers and illegal traders.

There are vast areas of agriculture potential fields. Mining activities is directly related to the IndawGyi environment and human health that major concern to decision makers and stakeholder organizations and individuals. The villages, along the road to Hpakant, and Mohnyin Myo are growing migrant who are fishing in the Indaw Gyi Lake is challenging the socio-economic activity.

Nature and Wildlife Conservation Division of Forest Department conserves this area. IndawGyi Lake, its catchments and Indaw Chaung are protected by the IndawGyi wildlife sanctuaries. IndawGyi Lake is high potential hot spot of eco-tourism for the future. As local people need to understand the systematic eco-friendly cultivation, management and technique should be discussed. In considering rain feed farming system, crops adaptation to physical conditions such as soil type, climate, and natural environment with minimum investment and maximum potential value are valuable.

According to field observation Le, Ya and gardens are mainly important in Mohnyin. There are potential agriculture areas can be studied along stream channel wide valley plains in Mohnyin Township and should be extent to agriculture area to increase crops production as change of agriculture pattern.

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