

## **Human's Adaptability to the Environment and Socio-Economic Development: A case study of *Yemyet In* Area**

Aung Kyaw<sup>1</sup>, Mya Thaing<sup>2</sup>, Nay Win Oo<sup>3</sup>, Zaw Latt Tun<sup>4</sup>, San Myint<sup>5</sup> and Associates<sup>6</sup>

### **Abstract**

In developing countries, majority of the economic activities are related to conditions of given natural environment. In areas where natural environment is harsh and always changing people automatically adjust and adapt to the given conditions. It always has alternative choices of economic activities for the people living in regular changing environment. However, these alternative economic opportunities are changed or diminished when unprecedented climatic changes or policy interventions are involved. In that case, socio-economic conditions of the people living in the area would lead to critical situations. This paper examine the above assumption based on data derived from the intensive field surveys conducted to the villagers of *Yemyet In* area during January and February 2006. It is found that human adaptability to the regular environment changes is different among the villages located at the edge of the *Yemyet In*. The adaptability is highly based on the given natural environment, nature of people, and accessibility to the nearest town, etc. The impacts of development policy on the human adaptability of local people are also very clear. Finally, the paper discussed the concept of human adaptability in the application of socio-economic development of an area.

**Key Ward:** Human Adaptability, Alternative Economic Opportunity, Socio-Economic Development

### **Introduction**

Human being lives on the earth surface and uses the natural environment for their living. There are competitions among people for the natural resources because existing resources are limited for growing population or existing resources are depleted due to over exploitation. Sometimes natural environment is changed due to some major events that occur in the whole earth system. Climate change and its subsequent effect on the agriculture is a distinguished example. People living in the area of harsh

- 
1. Lecturer, Department of Geography, Taungoo University
  2. Retired Professor, Department of Geography, Yangon University
  3. Lecturer, Department of Geography, Pyay University
  4. Lecturer, Department of Geography, Sittwe University
  5. Professor, Department of Geography, University of Education, Sagaing
  6. Ph. D. candidates (Geography) from Yangon and Mandalay Universities

and regular changing natural environment automatically adjust and adapt to the given conditions. It always has alternative choices of economic activities for the people living in those regular changing environment. This concept is depicted in Fig. 1. Natural environment in any area has seasonal and periodical variations based on climate. In Myanmar there are hot, wet, and cool seasons. Occupation opportunities of an area varied with season. In addition, it also has a variation of climate in for some years. Rainfall, for example has a variation in certain periods of the year. Human beings tried to adapt their occupations to the changing environment for their survival. It means that any area should have major economy and alternative economy to sustain its population. Since people are well experienced with these two economies, they adapted their occupation to this changing environment by means of saving and working. Based on their economy social and cultural conditions are also developed that is related to its economy. With the development of social conditions (especially knowledge) people could be able to use natural resources effectively. Education and health are the good example of social conditions. People's traditions and culture are also well maintained in this system.

However, if the existing natural environment is abruptly changed due to some climatic change of human interventions, both the major and alternative economic opportunities are changed or diminished. In that case, socio-economic conditions of the people living in the area would be lead to critical situations.

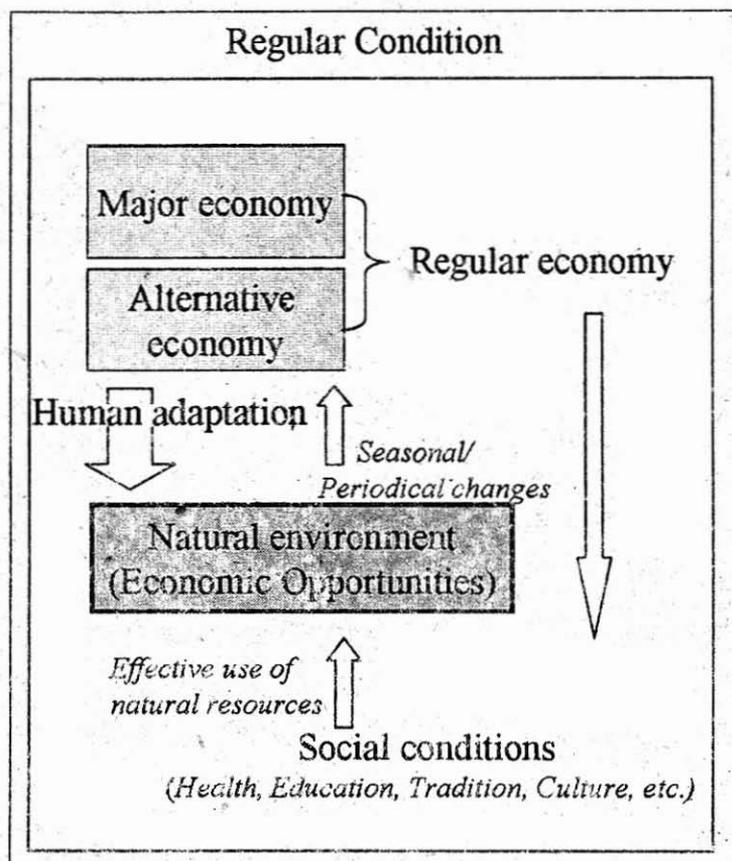


Figure (1) Concept of human adaptation to the environment and socio-economic development.

### Problem

Based on the above concept this paper tried to answer the following questions from the data derived from the intensive field survey conducted to the villagers of *Yemyet In* area during January and February 2006.

- (1) How does the natural environment varies in the villages of *Yemyet In* Area?
- (2) How do people adapt themselves to the natural environment?
- (3) What are the relationships between human adaptation and socio-economic development?

### Data and Method

To be able to answer above questions, intensive field survey and open interviews were conducted to the people from three villages (out of five villages) located at the edge of Yemyet In through several trips during March 2005 and April 2006. In addition intensive structured interviews were conducted to 91 households (28 from Padu; 36 from Yedwingaung; 27 from Yemyet) during 25 January and 3 February 2006.

Based on the field survey and interviewed results, the nature of natural environment is reconstructed. Then, the analysis focuses on the way of people's adaptation to the natural environment before depicting the process that forced the people to make such adaptation. Based on the above analysis the relationship between human adaptation to the natural environment and socio-economic development is discussed.

### Natural Environment and Economic Opportunity in the Study Area

Relief, drainage and climate are considered as major environmental conditions generating the economic opportunities in the given area.

#### Relief and Drainage

Yemyet In is located at the 23.3 Kilometers (9 miles) distance from Sagaing Town (Fig. 3). It is a wide (about 18.13 Kilometer) lowland, lying between Mingun Range (123meters (1322 feet) in it highest part lying along the western bank of Ayeyarwady River) and Shwetaungone (46.45meters (500 feet)) hill in the west. Southwestern part of this flat plain is also bounded by a hill called Phoe Khaung Taung (37.16 meters (400 feet)). There is a narrow flat plain near Saye Village in the southeastern part of the plain. Northern part of the plain extended for many miles up to Shwebo plain. From its topography, the rain falling in the surrounding mountain ranges and northern part of the plain accumulated as an open water surface into Yemyet In. From its location and topography the depth of the Yemyet In is very shallow. The southern part of the lake is relatively deeper than the northern part.

It receives about 33 inches of annual rainfall. Due to its wide area, the distribution of rainfall is not uniform. Due to its flat topography, varied rainfall distribution and high evaporation rate, the water level of the *Yemyet In* is ever changing. It is like putting water in a flat pan where water evaporates

from it. Its topography and climatic conditions generate two sudden water level changes: water could be filled up in the whole In area within one or two days if the rain is received in all parts of the flat plain; the whole In area could be dried up within a very short period.

Water level and area of Yemyet In is always changing in two directions: seasonally and periodically. Figure (2) shows the water levels for various periods. In general the In is dried up in every 3 to 4 years and need about 2 to 3 years to reach its highest water level again. Yemyet In is 14 miles long and 4 miles wide when it's maximum water level is attained.

There are 7 saline streams flowing into the Yemyet In from the southwestern part. Another 11 fresh water streams flowing into the In from the west and northwestern parts (San Myint, 2005). The salts and alkali carried by the saline streams are accumulated in the In. When the water is dried up the salts diluted in the In's water are accumulated on the soil. After many fluctuations of these dried up process throughout its history the water of the In become salty. In addition, alkaline and salts are accumulated in the soil of the southern sections of lake near Yemyet Village which is the lowest area for the whole In.

There is no natural vegetation and it is also impossible to cultivate in the southern part of the In since soap powder and salt are emerging. From Fig. (2) it is distinguished that the northern part of the lake water level is very fluctuating. If the rainfall is relatively low in the high water level period, the water does not reach the northern part. Therefore, northern part becomes swampy and vegetation such as "*Shinmwelun*" and "*Thetkel*" thrive there. In addition to the above periodical water level fluctuation, there is also seasonally fluctuations. Seasonal variation, however, do not have much affect on the occupation opportunities of the area.

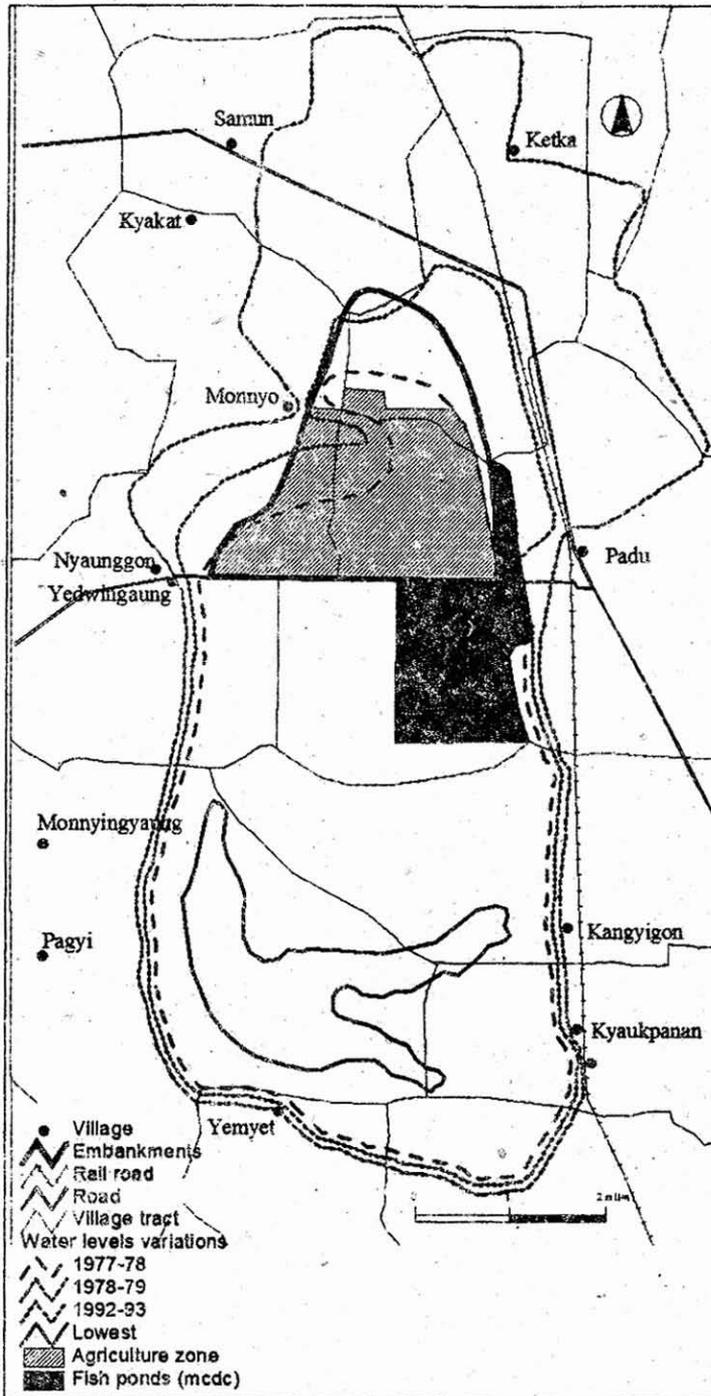
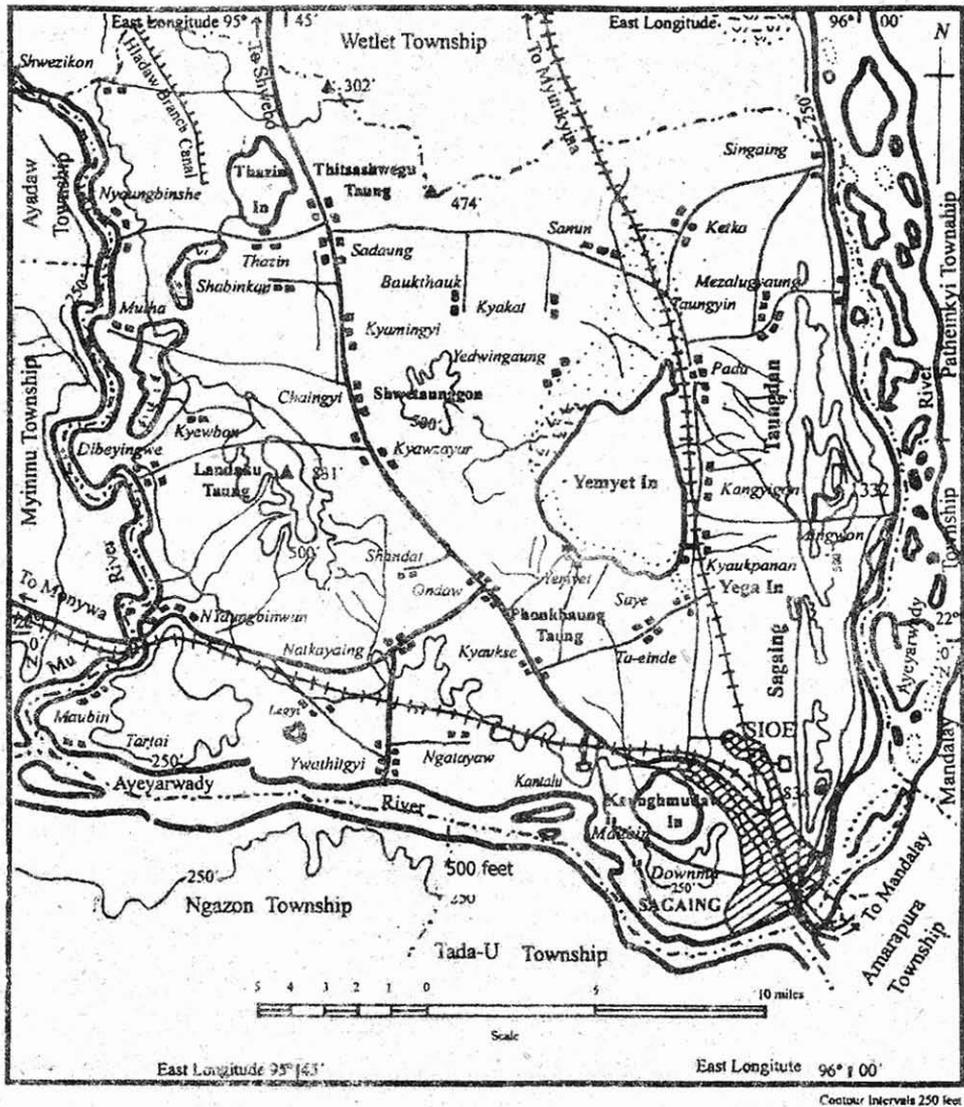


Figure (2) Water level fluctuation and development projects in Yemyet In  
 Source: Myanma Agriculture Enterprise, Sagaing Township.



Source: Topo Map No.84C, & No.84N, Department of Geography, University of Mandalay.

INDEX

- |   |   |                                |
|---|---|--------------------------------|
|  Town              |  SIOE                  | Sagaing Institute of Education |
|  Village           |  Stream                |                                |
|  All Weather Road  |  Canal                 |                                |
|  Fair Weather Road |  Township Boundary     |                                |
|  Sagaing Bridge    |  Yadanabo Bridge (New) |                                |

Figure (3) Location of Yemyet In and its natural environment

Source: San Myint, 2005.

## Climate

Figure (4) shows the spatial variation of annual rainfall in three weather stations located around the Yemyet In. Padu station is located in the eastern edge while Ta-einde and Ohndaw stations are located in southern and southwestern parts of Yemyet In, respectively. Rainfall data of western and northern part of the study area are not available. In addition, annual rainfall for Ohndaw station is continuously available from 1990 to 2005 and other two stations are available only for some years.

However, the spatial and annual variations of rainfall in the area could be identified from the Fig. (4). Annual rainfalls of Ta-einde station were higher than Ohndaw station during 1993 and 1997. However, its rainfall amount was lower than Ohndaw since 1997. In addition, annual rainfall of Padu station was higher than Ohndaw during 1993 and 1998. Although rainfalls of these two stations were not too different in the years of low rainfall period Padu receive more rainfall during high rainfall period. However, Padu receives lower rainfall than Ohndaw since 1999. Therefore, there is a clear spatial variation of annual rainfall distribution in the Yemyet In.

Fig.(3) reveals the annual rainfall variations where the annual rainfalls of all stations are sometimes increased and decreased each year; sometimes there is a two or three years increase or decrease continuously before its trend change again. This point shows that the study area have periodical variation of rainfall.

Based on the above spatial and periodical variations of rainfalls, the water level of Yemyet In is changing. It also means that the rainfall conditions supported to the farmers (especially *Ya*) in the study areas is not regular.

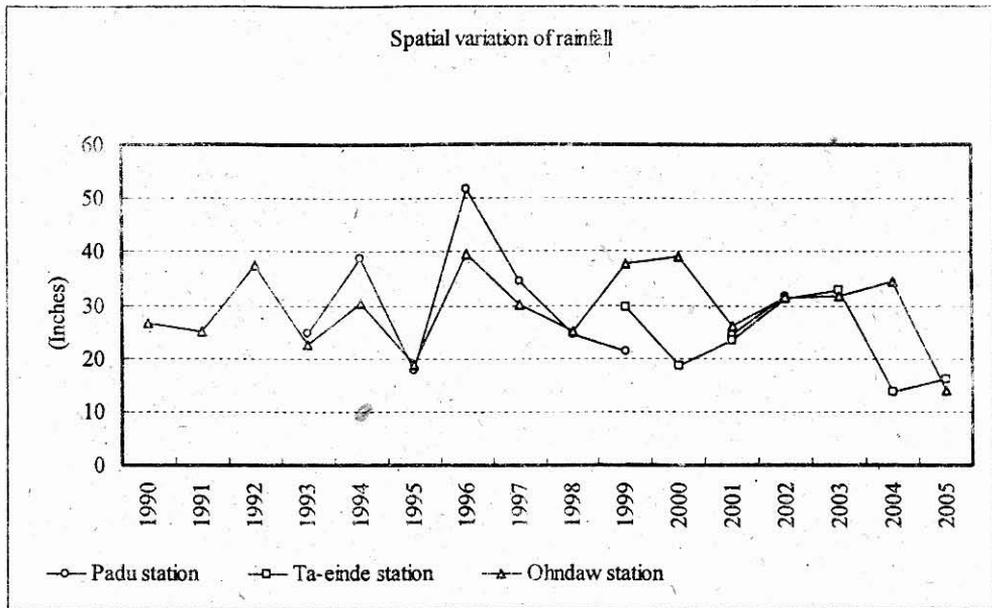


Figure (4) Spatial and periodical variation of annual rainfall in three weather stations

Source: Myanma Agriculture Service, Sagaing Township.

### Relationship between Water Level Fluctuation and Economic Opportunity

Water level of Yemyet In is always changing. In high-level period its water surface expanded up to 14 miles in north-south direction while it is totally dried out in some years (especially 2005). Its maximum width is about 4 miles from east to west (San Myint, 2004, P3). There are six villages located at the edge of Yemyet In: Padu, Kangyigon, Kyaukpanan, Ywathet, Yemyet and Yedwingaung Villages in a clockwise direction from the northeast (Fig. 2). Although Ketka and Monnyo Villages are located at the northeastern and northwestern part of In, the water level reach those villages only in the high-water periods.

Figure (5) shows the changes of total cultivation areas in seven village tract during 1999 and 2006. From this figure it is distinguished that *Padu* has largest cultivated area and in an increasing trend. *Saye* shows no distinguishable change although it is slightly increased for the last two years. Although the amount of agricultural land differs among Ketkha, Kyaukpanan,

Kangyigon and Yedwingaung Villages, they also show a near similar trend of agriculture development to that of Saye. *Yemyet* Village on the other hand, has only a small amount of cultivated land and its trend shows no distinguishable change or it shows a gradual decreasing pattern. Therefore, from Fig. 4, the villages located near Yemyet In could be divided into three groups: Padu, Saye, and Yemyet. Yedwingaung from Saye group that is located in the western bank of Yemyet In was elected as a case study. Then, specific study came to include Padu, Yedwingaung, and Yemyet Villages.

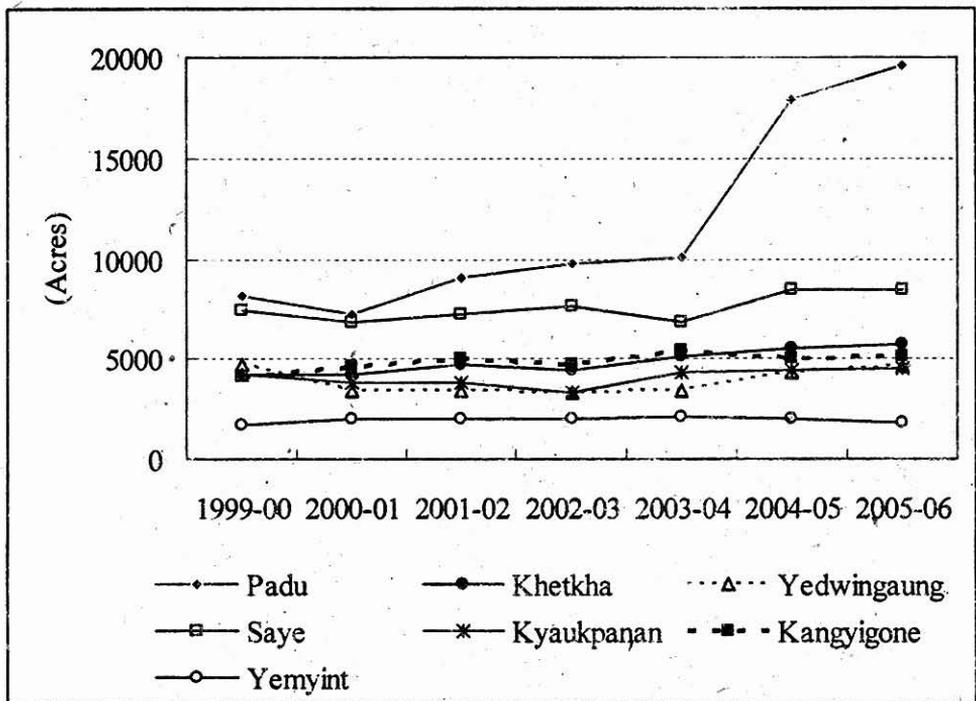


Figure (5) Changes in total cultivation area of village tracts locate in Yemyet In area.

Source: Myanmar Agriculture Service, Sagaing Township.

In figure (6) population of six villages located at the bank of Yemyet In is depicted. Padu, headquarter of Padu district has the highest population while Yewdingaung has medium population. Yemyet Village on the other hand has the lowest population. In terms of population, therefore, Padu,

Yedwingaung, and Yemyet also represent the large, medium and small population sizes.

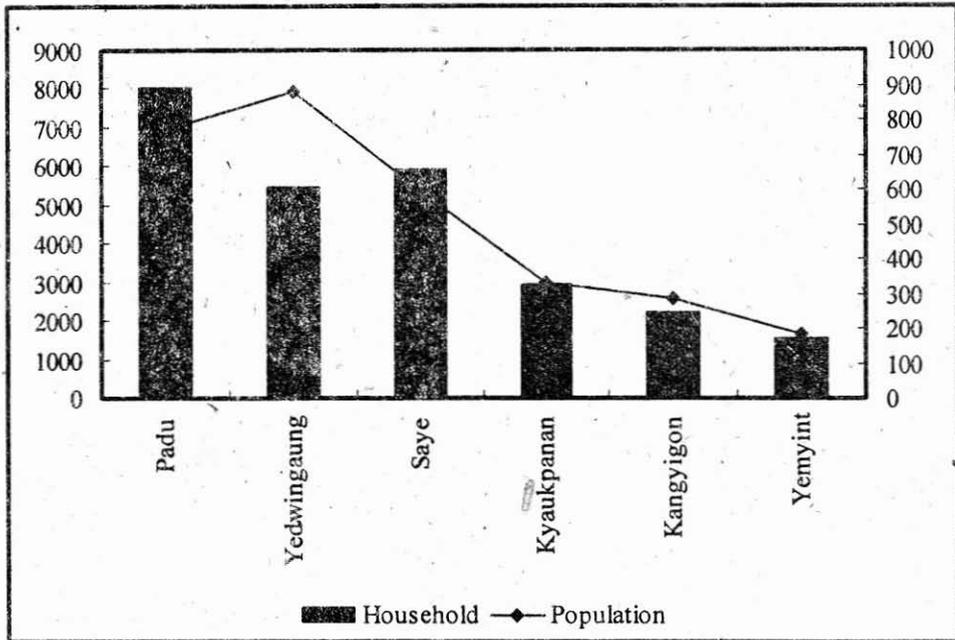


Figure (5) Population and number of household in village tracts located around Yemyet In

Source: Sagaing Township Peace and Development Council.

### A Case Study of Padu Village

Padu Village is located on the Sagaing–Sadaung Road. Sagaing–Myintkyina trains stopped at Padu station. In addition, Padu Village is connected to Yedwingaung by Padu–Yedwingaung Road. Therefore, it is the most accessible village among the villages located near Yemyet In. There are 893 households in Padu Village. Majority of the households are farmers and living in the eastern part of railroad. There are 200 fishermen households living in the place between rail road and Yemyet In (called “Agent Ward”). Padu has been thriving since early days due to its location on the Sagaing–Myintkyina Railroad and as a Padu Station. Thus, many functions are developed in the Village. Many families are engaged in services like transportation and running of grocery shops. Farmers also possess many acres

of lands. Therefore except during the time of floods, the economic condition of the farmers living in the eastern part of rail road is not directly affected by the fluctuation of Yemyet In.

Figure (7) shows the crop pattern changes of Padu Village during the last 7 years. Agriculture development trend of Padu is different from that of other villages chosen as case study. Its total cultivation area is greatly increased during last two or three years. It is due to the practice of double cropping by some advanced farmers and cultivation of summer paddy by means of pump-irrigation from the Ayeyarwady River near Taungyin Village. Cultivation area of peas and beans also increased recently. Since agriculture is expanded the job opportunities of the villagers became numerous compared to other villages of Yemyet In.

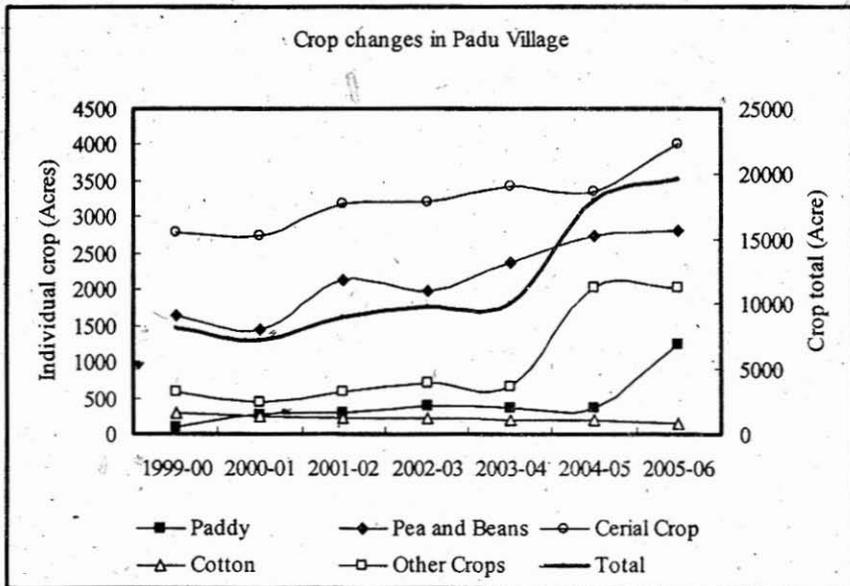


Figure (7) Crop pattern changes in Padu Village

Source: Myanma Agriculture Service, Sagaing Township.

Water level fluctuation directly affects more than 200 families living on the eastern bank of Yemyet In. All families living there are conducting fishing. When water level is low or dried up more than 60 percents of the fishermen leave their home and move to the Taphetsel Reservoir of Kyunhla

township, or Thaphanseik Dam, or Indawgyi Lake to continue their fishing. Only people who were unable to do fishing and students are left in the village to maintain their houses. Other 40 percents of families left the village and find other alternative jobs.

Padu is a large village and has many job opportunities in farming. Fishermen, however, hesitate to do as farm workers because they could not face the hard job. Therefore, they tried to save money during fishing period by means of pig breeding. Nearly all families have large number of pigs both big and small. They said that it is their saving banks. When they need money pigs are sold out. In addition, fishermen participated in reaping of Shinmwelun grass and Thetkel grass (*Myetmonnyin* in local name) and they make them into roofing-bar. Some alternative jobs are related to collection of Shinmwelun buds and making pillow and mattress by using wool derived from Shinmwelun buds. Many fishermen who do not move to other fishable part are mainly associated with this job. Some young people go to Mongoke and Phakhant for digging precious stones and gold. But some of them came back with some serious diseases.

In the time of high water, fishermen make large amount of money. They consume large amount of goods and alcohol. Therefore, services and shops are also doing their business very well. When the water level is low or dried up all services and shops lost their customer or purchasing power because the remaining number of fishermen was limited.

### **A Case Study of Yemyet Village**

Yemyet Village is located at the southwestern bank of Yemyet In and it has the lowest population among the villages located near the Yemyet In (Fig. 3). There are 137 households living in Yemyet Village. Although there is natural increase of population, the people or families who became rich usually migrate to the town or Mandalay City. Therefore, total population of the village does not change for a long time. Transportation to the Yemyet Village is comparatively more difficult than other villages. One can travel to Yemyet through the Saye Villge or directly from the Sagaing-Monywa Road. The road, however, are mountainous and rough. Therefore, there is no regular Twalerjeep bus running between Yemyet and Sagaing or Mandalay. Villagers mainly depend on bullock carts as main transportation mode.

### Agriculture as a major economy

Of the 137 households, 115 are mainly engaged in farming. About 100 farmers, however, owned only 1 to 6 acres of land and it is difficult to survive on farming alone. About 5 or 6 acres of land could feed the whole family of 4 or 5 peoples in lower Myanmar where rainfall is regular and abundant to cultivate many kinds of crops. In the study area the rainfall is very uncertain and sometimes it is impossible to cultivate throughout the year. There are two types of land in the study area: *Ya* (dry cultivation) and *Le* (wet cultivation). Majority of lands are located on the hill slopes and could cultivate as *Ya*. Some agricultural lands located in the flat plain area are generally called as *Le*. However, the land plot would be cultivated with rain-feed paddy or other *Ya* crops such as gram, peanut or sesame depending on the condition of rainfall. If rainfall is high enough to grow paddy they grow paddy. If rainfall is not sufficient *Ya* then crops will be substituted. One interviewed *Ya* farmer said "He had to take the farm implements with him when he go to the *Ya* land, because if it rains the farmer have to plough and sow the seeds directly. If he did not bring the farm implements together with him, it is too late for the seeds to absorb enough moisture from the soil for their growth. In that case the farmer has to wait one more rain or year for cultivation".

Figure (8) shows the cropping pattern of Yemyet Village during last 5 years.-The total cultivated land of the Yemyet Village had not increased during last two or three years. It was due to lack of both expansion of agriculture land and not practicing of double cropping. Since the villages of the adjacent areas of the In is covered with the excessive alkaline soil, there is no vegetation and it is also impossible to grow crops.

Figure (4) shows the nature of rainfall. It highly controls the cropping pattern of Yemyet Village. There is no crop that constantly grew through out the 7 year period. Because the choice of crop is dependent on the weather conditions rather than the market and farmer's preference, the farmers have to buy many kinds of seeds. It is too late if they buy the seed after experiencing the weather conditions only. Therefore, farmers have to invest relatively more money on seed. In 2005, there was no rain for six months. Therefore, farmers were faced with the problems of cattle feeds. They have had to sell out their small cattle to buy fodder (maize) for large cattle. It is a motto in the region that "Small cattle (calf) are eaten by large cattle".

Therefore, it can be concluded that the agriculture in the Yemyet village is not too reliable for small farmers. There are only 15 farmers that

owned more than 25 acres of land. They can live on their land. Other 100 farmers have between 6 to 25 acres of land and are dependent on the alternative jobs for their survival.

### **Fishing and other alternative economic activities**

Fishing is an alternative job for some people living in Yemyet Village. There are 23 people conducting in fishing. They are permanent fishermen and earn a large amount of money from fishing. However, when the In's water dried up or water level become low they have to change their jobs. The difference with the other two villages (Yedwingaung and Padu) is that only a few fishing families temporarily move out to place where fishing could be conducted. They keep living in the village and tried to work on alternative jobs. Some fishermen breed sheep and pig. Some people work as paid farm workers or as daily wage earners. The head of the family who lead fishing during the high water level period is generally doing nothing in the dried up period. He is just keeping the house and children. His family members have to work in other areas.

Small farmers who owned only a few acre of land have to do alternative jobs. They generally are engaged as farm workers in the farms of large farmers. Some people go to Sagaing and work there as a daily wage earners. Another job that could be done in Yemyet Village is collection of alkaline powder. Water with high alkaline solution evaporates to the surface through capillary action and dried up on the surface. Some villagers collect these alkaline soils and sell in Mandalay for cleaning used bottle. Some small farmers breed cattle for their survival during the dry period.

During the high water period about 125 families temporarily moved into the village to conduct fishing. They stay near the bank of Yemyet In and do fishing. Although fishermen from the villages are conducting fishing on a small scale, immigrants include both small scale and large scale fishermen. The equipments used by immigrant fishermen are more advanced than the local fishermen. They are more capital intensive. Sometime they construct a video house and tap money from the villagers. Villagers also received some benefits from the fishermen by means of selling some betel and cigarette to the fishermen, hiring the bullock cart to move their belonging, to transport fishes to the Sagaing-Monywa Road.

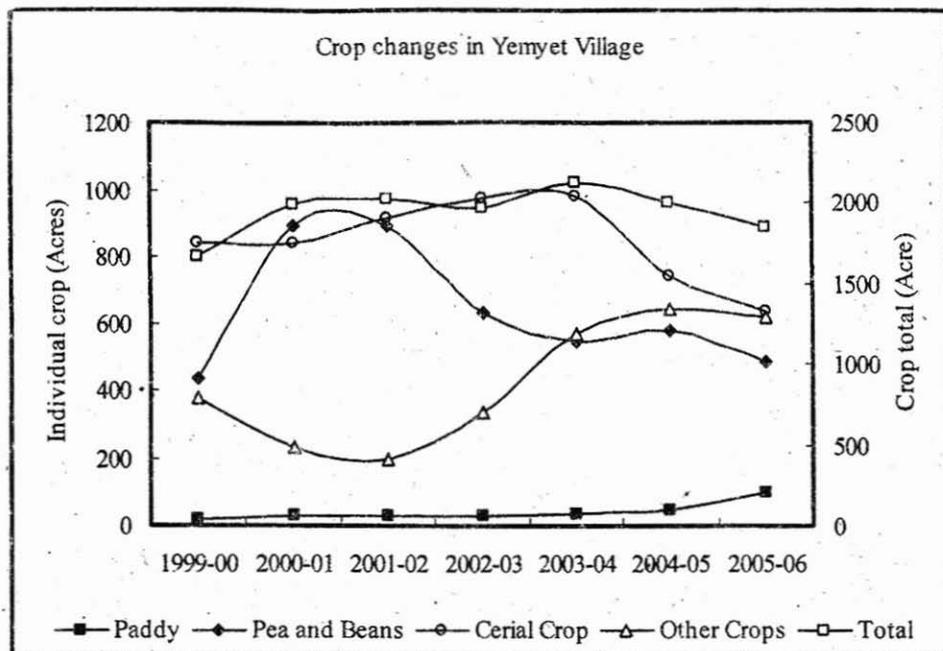


Figure (8) Cropping pattern in Yemyet Village during last 5 years

Source: Myanma Agriculture Service, Sagaing Township

Since most of the people living in the village strongly believe in Buddhism and accepted fishing as a bad occupation they hesitate to do it. Some people do not even breed pigs. Although many villagers are not directly involved in the fishing they somehow benefited from it. Therefore, there is no problem with the alternative job during high water period.

In low water or dried up period all immigrant fishermen move out to another place and many alternative economies evacuated together with them. Natural environment of Yemyet does not give much chance for alternative job. Therefore, many people including small farmers and fishermen have to face with problems in their occupation.

### A Case Study of Yedwingaung Village

Yedwingaung Village is located at the western bank of Yemyet In. Before the construction of Padu-Yedwingaung Road, commodities and passengers used Yedwingaung- Ohndaw earth road to reach the Shwebo-

Sagaing Road. Padu-Yedwingaung Road was only usable in low water-level periods. In 2001, Padu-Yedwingaung Road was constructed as a permanent road under the supervision of North-west Command. As a result, the accessibility of the village became better. Since Yedwingaung-Ohndaw Road is mountainous, commodities and people generally used the Padu-Yedwingaung Road to reach Sagaing.

There are 470 households in Yedwingaung Village in 2006. Of them, nearly 150 households are engaged in fishing while another 150 are farmers. The rest (170 households) are living on dual economy of fishing and farming (Fishermen-farmer).

Of the 150 farmers, nearly 50 owned more than 30 acres of land and could be said as true farmers since they could live on farming alone. The rest 100 farmers owned 2 to 6 acres of land and could not survive on farming alone. Their family members have to work as farm workers at the farmland of other villages. They also have to collect Shinmwelun and Thetkel (thatch) and make roofing-bar as alternative job.

Fishermen-farmers are doing both fishing and farming in the high water period. They usually owned small pieces of land and are impossible to live on this land. But they have to find alternative job when fishing is impossible during the low-water level period. Their family members have to work on the farms of other villages as wages-earners. Some family members also collect thatch and make roofing bars as alternative economy. Therefore, in the low-water level period, daily wages earning and thatch collecting are become alternative economy for small farmers and fishermen-farmers. Since low-water level is a result of insufficient rain, farm wage earners are not doing well in the village. They have to work on a land of other villages as a temporary migration basic.

Fishermen mainly based on the water level of Yemyet In have critical job situation in the area. During the high-water level period, they usually earned large amount of money. But they do not save money like fishermen in Padu Village in the high-water level period. Instead they solve the problem by means of temporary migration to places where fishing is possible. Fishermen usually moved out to Thaphanseik Dam, Thaphetse Dam (Kyunhla Township). Of the fishermen, 100 moved out to the above places. They usually bring their children with them and their houses are closed during that period. When water level of Yemyet In rises, they move back to Yedwingaung again. In that period they also bring their friends from other parts of the

country. These temporary migrated fishermen settled in the village. They are not allowed to live outside.

Fifty fishermen remaining in the village have to find out their alternative economy by means of hunting and collection of thatch. Although nearly all houses collect and make thatch for their own house, there are about 50 households who conduct thatch making as an alternative job.

Figure (9) shows the changes of cropping pattern in Yedwingaung Village during last 7 years. Total cultivated area decreased since 1999-2000. But it increased again in 2004-05. The agriculture of the village is dependent on both climate and water level of the In. During 2000-01 and 2003-2004, water level of the In is relatively high and it is impossible to practice cultivation in the margin of In. In that period, area of pulse and beans grown are decreased. Agriculture land of the Yedwingaung Village could be divided into Ya and Le. Major crop of the area is sunflower, wheat and paddy. Paddy cultivation is encouraged recently and cultivation acreage increased since 2004-05. Area of cereal crop including sunflower is also increasing since 2003-04. As a result total cultivation area is increasing during the last two years.

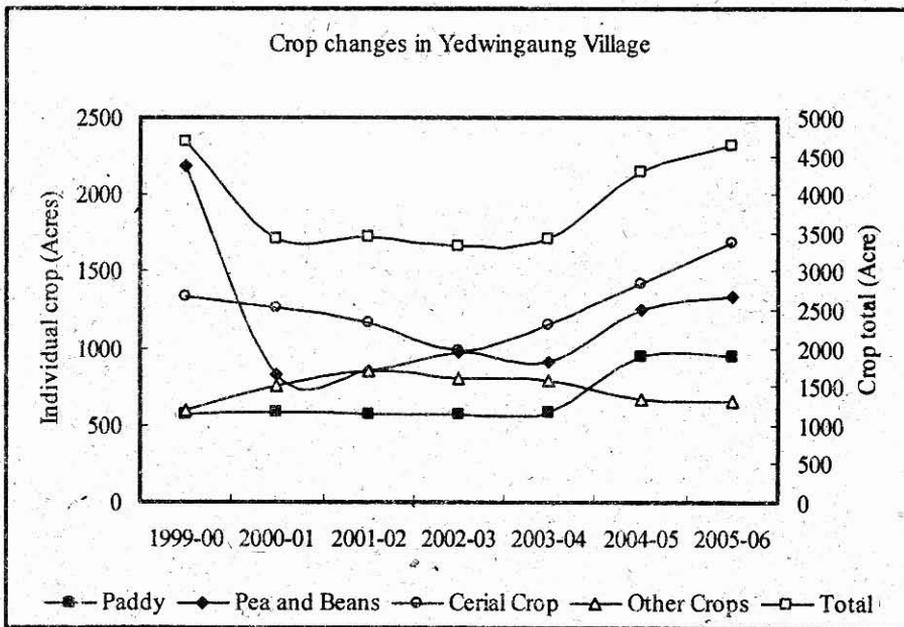


Figure (8) Cropping pattern of Yedwingaung Village during last 5 years.

Source: Agriculture Department, Sagaing Township

Yedwingaung differ from other villages, because watermelon started growing in 2002. Both large farmers and small farmers grow one or two acres of watermelon on their lands. Since farmers used hybrid seeds imported from Taiwan the quality and yield are relatively high. In the early days farmer sold watermelons to the broker in the village. Since last year, however, they transport watermelon to Mandalay market and sell directly to the wholesalers. The wholesalers export some watermelon to China. With the introduction of this new crop the economic conditions of the small farmers are increased. There are about 100 acres of watermelon in 2005.

Other alternative jobs are also found in Yedwingaung Village. There are about 50 cloth weaving works in the village. It is generally conducted by the family member of small farmers. Each comprises of 1 to 3 hand-driven weaving machines. They take raw materials from Amayapura Township, Mandalay and send back finish products there. They earn their wages from weaving and do not need to worry about the raw materials and market. Sewing is another alternative job that small farmers are engaged in. Nearly all large farmers own sewing machine and sew their clothes themselves. There are about 25 small farmer families who earn extra money by sewing.

In addition to the above three categories of occupation (fishing, farming, fishing-farming), there are about 25 household who's living is carried on by running grocery shops in the village. They are mainly emphasized on service. These families are highly dependent on the economic condition of the above three categories.

Of the four categories of economic based people in Yedwingaung Village, farmers are well adaptable to the environment change. Large farmers could survive since they have capital investment and large area of land. Small farmers are also relatively adaptable to the environmental change by means of watermelon and tomato growing in the wet season and engaging of alternative jobs like weaving, sewing and collection of thatch. Fishing-farming families, on the other hand, have relatively few alternative jobs. Their family members have to work as wage earners in the farm of large farmers and collect Thetkel and Shinmwelun and make roofing-bars. They are not engaged in weaving and sewing. Pure fishermen who do not conduct other jobs generally moved out to other fishing areas during low-water level period. Remaining families in the village who are small in number, work by hunting or collecting thatch. However, with the expansion of agricultural land and fishing ponds through the development projects, the availability of thatch becomes very difficult.

They have to compete with the small farmers and some fishermen families in that job.

## **Human Modification of the Nature by Means of Development Projects**

### **Development Projects in the Area**

Padu Village located in the eastern bank of Yemyet In is also one of the railway stations on Sagaing-Myintkyina Railroad. In addition, there is an earth road between Padu and Yedwangaung across the Yemyet In. Sadaung-Padu-Kaungmudaw-Sagaing road is connecting between Sadaung in the northern part of In and Sagaing (Fig. 3).

Due to floods that occurred in 1978 and 1979, irrigation department implemented a project to dig the diversion canals in Yemyet In in 1980-81. Although some canals were completed the project as a whole was not completed due to insufficient capital, machines and fuel.

In 1989 canal construction and agriculture land development project was implemented under the guidance of the commander of northwest command. Throughout the project the canal was dug between Yemyet In and Kaungmudaw In with the purpose of diversion of water from the Yemyet In and to protect the flood. Kaungmudaw In is located in the southern part of Sagaing-Manywa Road. Through this project agriculture lands were also implemented in the northern part of Padu-Yedwangaung Road (Fig.2). In 1989-90, 12216 acres of waste lands were plotted. Of them, 3110 acres of lands were changed into agricultural land. Agriculture lands were ploughed by using large tractors with the aid of agriculture mechanization department. The lands are allowed to cultivate and grow crops to the departmental concerns. Then, 500 acres of wheat and 800 acres of sunflower were grown on that land in 1990. In addition to departmental concern, farmers from the 4 nearby village tracts were also allowed to grow crops on the newly implemented land as a joint venture of Tamadaw's farm. Through this joint venture system 83 acres of wheat and 1753 acres of sunflower were grown in 1991 (PDC, Sagaing, 1993).

As a center of agriculture development an office was constructed in the southern part of Padu-Yedwangaung Road. Within this office 8 fishing ponds (4.48 acres in total) were also constructed and breed the fish.

In July 2001, rice cultivation and animal and fish breeding project was implemented under the supervision of Mandalay City Development Committee. Through this project reinforcement of Padu-Yedwingaung Road was carried out to be able to control the water by using sludge gates. There are 3 sludge gates on the Padu-Yedwingaung Road that controlled the circulation of water between north and south. Then, large fishing ponds were constructed in the southern part of Padu-Ywdwingaung Road (Fig. 2).

Through this project implementations Yemyet In' s ecosystem was divided into two: northern and southern parts of Padu-Ywdwingaung Road. Northern part of the In was changed from swampy natural vegetation such as "Shinmwelun"; and "Thekel" to farm lands. Bottom of Shinmwelun grass is a place where fish laid down their eggs and migratory birds live in winter. The southern part also changed from swampy vegetation to fish ponds. Therefore, these natural vegetation are contributing to the fishing development and facilitating the movement of migratory bird was cleaned out through this project.

### **Natural Environment, Development Projects and Human Adaptability**

Although development projects are continuously carried out in Yemyet In since late 1970s, some failed to fully actualize the project. Of them, some are the result of weaknesses of project itself. Construction of diversion canal in 1980-81, for example, was not completed due to insufficient supply of capital investments. Diversion canal construction project of 1989 also failed to fully actualize due to lack of consideration of the nature of topography exiting between Yemyet In and Kaungmudaw In. Therefore, landslides occurred along the diversion canal and canal itself was blocked with eroded soil.

Other projects are completely implemented. But the extent of their effectiveness on the local people is not clear. One important factor relating to the effectiveness of these projects is the nature of periodical climatic change and subsequent water level fluctuation. In the high water level period, agriculture lands located in the northern part of Padu-Yedwingaung Road are flooded with saline water (although embankment was constructed) throughout the year. Due to its high salinity content it is impossible to grow rice. During the low-water-level period the soil is suitable for the cultivation of wheat. Therefore the majority of newly developed lands are cultivable only during

the low water level period. Again in the dried up years, there is no sufficient water to grow wheat.

In 2005, however, some wise farmers tried to dig artesian well on the dried In's. But it could be used only in low water level and dried up period. During the high water level period the lands are covered again with water and swamp vegetations thrive again. Therefore, it is also necessary to clean up the land again in next period. Fish ponds dug in the southern part of Padu-Yedwingaung Road could hold water only in the high water period. In low water periods, it dried up due to high evaporation rate. Since the bottom of fish ponds are cleaned up, natural vegetation (especially Shinmwelun grass) which are very useful for living and egg-falling of fish are diminished. Shinmwelun grass itself has it's own economic value as a alternative job opportunity for local people. Therefore, it can be said that the projects implemented in the Yemyet In created changes in the natural environment and its offers as an alternative jobs.

### **Conclusion: Human's Adaptability to the Environment and Socio-economic Development**

As mentioned in the previous section, environment of Yemyet In generates various major and alternative economies for the people living around the lake. Due to its harsh climatic conditions and related water level changes, people have to adjust to the environment by means of changing jobs, emmigration, and money saving, etc. Implemented development projects, especially, farm land project and fish pond projects are affected to both major and alternative economy of local people. The places implemented by the development projects are mainly located in the both side of Padu-Yedwingaung Road where swamp vegetation is found. MCDC subcontracted out the fish ponds project to the private entrepreneur. Then private entrepreneur extended their fishing area to the deepest area of In. Therefore, fishing area for local people was reduced in recent years. In addition, due to construction of fish ponds and implementation of farm lands Shinmwelun and Thetkel were wipe out. For long terms it could affect the fishing and migration of winter birds since those plants are main places of fish-egg laying and winter bird-nets. Many people from the nearby villages are dependent on the swampy vegetation (Shinmwelun and Thetkel) for their alternative economy. Although the economic impacts of the development project on the local people are not too distinguished during HWL period (major economy) their

impacts is very strong in LWL period (alternative economy). Due to economic stress more and more people from Padu and Yedwangaung temporarily moved out the other places where fishing is possible and could earn money. Some of them return to their own village with severe diseases.

It is also found that the human adaptability to the regular environment changes is differed among the case study villages. The adaptability is highly based on the given natural environment, nature of people, and accessibility to the nearest town, etc. Padu that has its large farming population and located in advantageous location for agriculture could be well adapted the changes. But its good transportation also encouraged some fishermen to breed African catfish as an alternative economy. Yemyet Village with its poor transportation and harsh natural environment, and specific culture (belief) of people, has few alternative jobs for both farmers and fishermen for their living. Yedwangaung located on the western bank of Yemyet In has many alternative jobs for small farmers. These alternative jobs are created by themselves by means of sewing, waving, etc from developed area and distribution of it within the village.

In general, loosing of major and alternative economies in an area could lead to problems in some occupation. This occupation difficulty will lead to social deterioration. Since people of various occupations are living in the same village social deterioration of one group could generate subsequent social problem in the area. Breeding of African catfish in Padu village is a good example of it. There are two fishermen breeding African catfish in Padu. Although breeding of this type of fish is officially banned by order No. 5/2001 of fishery department (Khet Myanmar Weekly, Vol. 3 (29), 28 April 2006) due to lack of alternative job and knowledge they breeding it in an insecure environment. There is no systematic fence to prevent the fish from escaping in the ponds. Therefore, fishes could be easily escaped from the pond and arrive into the Yemyet In. From the interviews it is understand that they caught one African catfish that has 8 Visses from the In, last year. Therefore, it is highly possible that African catfish is already escaped into the In. With the continuing and expansion African catfish breeding more and more fish will escape to the In. Then, many fish species will be diminished by being eaten by African catfish. Lack of alternative economy finally could generate unbalance Lake's ecosystem in the near future. As a subsequent, socio-economic development of the people living around the Yemyet will be affected in the future.

Therefore, the relationship between human adaptability and socio-economic developments could be summarized as in Fig. 8. Although human being is adapting to their natural environment for a long time, their adaptability sometime failed to catch up with abrupt change of natural environment. Abrupt change could occur by both global and local scale changes. Local scale changes are generated by means of human intervention of nature. In that case natural environment is changed in the first place. Then, the major and alternative economies of local people are affected. People tried to solve this changing environment by means of migration, change of occupations, etc. However, if new alternative economy is not timely developed, social consequences will occur and these social consequences will affect again on the natural environment.

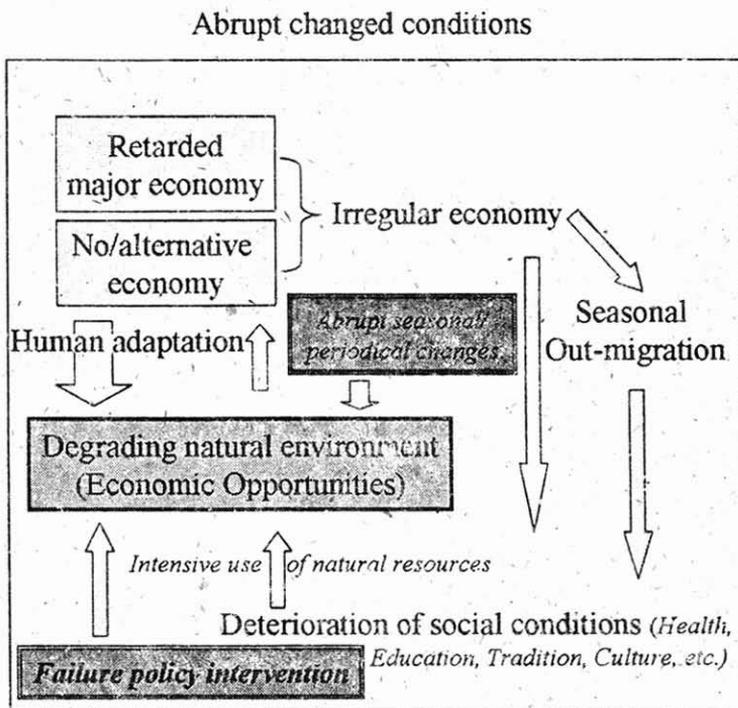


Figure (9) Human adaptability and socio-economic development

Notes: This paper is a part of the result of field training (2006) for Ph.D (preliminary) students of Yangon and Mandalay Universities. Other Ph.D candidates participated in this field training include U Min Aung Pan, U Aye Ko, Daw Zin May Oo, Daw Soe Soe Khin, Daw Khine Myint Cho, Daw Khin Mar Yee, Daw Mu Mu Than and Daw Khaing Le Win from Yangon

University, U Nay Aung, Daw Cho Cho San, Daw Cho Mar Sein and Daw Cho Cho Win from Mandalay University.

### **References**

San Myint, (2004) *Local Need 10%*. Research paper submitted to Sagaing Education University.

San Myint, (2005) Characteristics of Yemyet In, Sagaing Township. *Paper presented to the School Family Day (2004-05) Paper Readings (Earth Sciences)*, Conference Room, Yangon University 1-3 January.

Township Peace and Development Council, Sagaing (TPDC, Sagaing), (1993) *Town Record 1993*, TPDC, Sagaing.