

# **Farmer Vulnerability Amidst Climate Variability: A case study of Dry Zone of Myanmar**

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## **1. Introduction**

This paper highlights the causative factors of farmers' vulnerability to climate variability, particularly in the central dry zone of Myanmar. Dry zone, itself has unlikely climatic conditions such as high temperature, scarce rainfall etc. Drought is the natural event there. Drought (slow onset disaster) is the most serious disaster in terms of shortening people's lives. The slow onset event that occurs daily and is inherent in normal life causes millions of death at a time, even though those tragedies are less noticeable than earthquakes or floods (Blaikie et al (2004). In the dry zone, this unexceptional tragedy occurs as part of normal existence; thus, farmers in the area are embedded in this potential threat.

In Myanmar, central dry zone area is known as "oil pot" of the country, because its weather condition favors drought resistant, edible oil crop such as sesame and groundnut. Thus, dry zone is essential to fulfill the subsistence needs of nations. Myanmar now pays special attention for all-round development of the country in this transitional period. Its economy is still mainly depends on the agriculture because the agriculture sector mainly contributes country's GDP, provides substantial raw materials for agro-based industrial development as well as creates employment opportunity and food security for rural people. Thus, economic growth of the country through agricultural development is essential in prenatal economic life. However, current climate change effects are now threatening agricultural crops and farmers' livelihood. So, climatic condition is the key factor for agricultural development and farmers' livelihood.

Myanmar has been experiencing climate variability effects since decades. According to the Initial National Communication (INC) project report jointly implemented by National Commission for Environmental Affairs (NCEA) and UNEP, it is stated that "Prior to 1977, the average number of rainy days per annum used to be around 144, but it reduced to 103 in 1997. In the period from 1988 to 2000, the monsoon duration was shortened by about three weeks in the northern part and by one week in other parts of Myanmar compared to the 1951 - 2000 average. The year 2009 was an El Nino year with decreased annual rainfall, with heavy rains in some areas and with droughts in others". This is the evidence for climate change condition in Myanmar.

Learning from the other countries' experiences, the persons who have less adaptive capacity suffer more severe impacts. Blaikie et al. also points out that the level of a household's unsafe condition depends upon the initial level of well-being of the people, which is influenced by the patterns of access to tangible (cash, food and agricultural equipment) and intangible resources (a network, knowledge and sources of assistance). Unsafe conditions can be counted as having a physical and social nature, with physical unsafe conditions including dangerous locations and unprotected risk, whereas social unsafe conditions comprise livelihoods at risk and lack of disaster preparedness. Thus, dry land farmers, who take part as the back bone of country's economic development, get substantial impact because of their nature of job (social unsafe) and regional constraints (physical unsafe). Accelerating environmental threats and socio-economic forces, farmers in the research area fall into the debt trap and certain amount of farmers degrade and become landless. In this transition, to overcome these challenges and risks and to take actions in advance for economic development, analysis of farmers' vulnerability due to the climate

variability plays the main role as a basic. Thus, this paper tries to analyze which contexts force farmers to be vulnerable under natural hazards.

## **2. Theoretical Review**

### **a. Defining climate variability**

Climate variability refers to variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate on all temporal and spatial scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external forcing (external variability). (IPCC report)

### **b. Defining vulnerability**

The concept of vulnerability has been known and become familiar in association with climatic factors and natural disasters. In the IPCC (2007), vulnerability is identified as a functional effect of climate variability exposed to a system which has susceptible defensive capacity to adverse effects. From the social science perspective, vulnerability encompasses the economic and institutional context, apart from the physical dimension of environmental threat. (Hewitt, 1983 - cited in Adger, 1999, 251).

Blaikie et al. (2004) also insist that people's vulnerability comes through their normal existence. They defined that 'the characteristic of a person or group and their situation that influence their capacity to anticipate, cope with, resist and recover from the impact of natural hazard (an extreme natural event or process). According to Blaikie's idea, vulnerability has three sets of links: root causes, dynamic pressure and unsafe conditions. Root causes are mainly related to economic, demographic and political processes while dynamic pressure behaves as a kind of catalyst of change – based on the effects of the root causes and leading to unsafe conditions in relation to hazard types.

Hazard and risk have the nature of time and space effects. The occurrence of a drought in a dry area is a natural phenomenon and thus the agrarian-based household in that area has a more significant level of risk to such kinds of natural hazard, and may lead to the sub-division of land holdings, declining agricultural yields under the increased variability of unreasonable drought and rainfall, food insecurity and the likelihood of famine (Blaikie et al. 2004). To develop a better understanding of people's vulnerability, I mainly referred Blaikie's idea and I examined the environmental and socio-economic causative factors of vulnerability.

### **c. Case Study in Dry Zone Area**

Dry land ecosystems are very fragile ecosystems and so more vulnerable than other ones to resource overexploitation, inappropriate land use practices and climate change. In Myanmar, dry land area is located at its central region, which occupies 10% of the total area of Myanmar (54,390 sq. km) and contains 57 townships and thirteen districts, and is home to sixteen million people (one-third of the total population of Myanmar). Dry zone area is defined by the annual rainfall amount, being less than 40 inches (101.6 cm) is known as the dry zone (L. D Stamp (1964) cited in Saw Myint Tun, 1989-90).

Here, Mon Nyin village is selected as research area. It is located in Myaing Township, Pakokku District in Magway Region. Magway is the core region of the hottest area in the dry zone. The village is located at the southern edge of Myaing township, which is dry and has few natural resources, and is seventeen miles far from Pakokku township.

According to the village administration data, 96 households are farmers who possess land and draught cattle, while 52 households possess only land and 36 are non-farmers (wage laborers). Village's economy mainly depends on oil seed crops such as sesame and groundnut. Paddy cannot be grown due to water scarcity and so agricultural activity only favors rain-fed cultivation. On the other hand, there are only few natural resources, and so they have only the limited income opportunities. Moreover, support from the Governmental and Non-governmental organizations for agricultural development is negligible that they have to rely on their own efforts in order to survive from this condition.

### **3. Nature of dry land setting**

Dry zone area is located between two elevated regions-the Shan Highlands to the east, and the Rakhine Yoma and Chin Hills to the west. Thus, it is low land plain area and favors agricultural activity. The longest river, Ayeyarwady, passes through central dry land region and so the irrigated cultivation is also possible alongside the river. In this paper, I mainly focus on the experiences of rain-fed cultivators who have more risky and tired even in the agrarian community. Due to the advance and retreat of tropical storms, the precipitation pattern in the dry zone area can be characterized as a double maximum (bi-modal) one, with an early wet season (pre-monsoon) and a late wet season (post-monsoon) occurring. The pre-monsoon starts from April to June and post monsoon extends from September to October. The bi-modal rainfall pattern favors a double cropping system for dry land farming, meaning that farmers grow twice on the same plot each year, and in which a second crop is planted after the first is harvested. In one cropping season, farmers may grow one or more crops by intercropping (alternating rows) or mixed cropping (spreading), in order to ensure production from at least one crop as insurance against the unreliable rainfall.

As they mainly depend on agricultural activity, almost all of family members work at this work as household labor. However, in recent years, because of unpredictability of agricultural activity due to climate change, especially youth from households go outside to find other income opportunities which lead to decreased work force in agricultural. Better-off farmers mostly hire the labor throughout the year or at least the whole harvesting period, while most of middle or small farmers engage reciprocity with each other. This kind of cooperation solves the problem of labor deficiency during harvesting period and also reduces the labor charges.

Normally, farmers who practice rain-fed cultivation have to make continuous effort for their crops. The farmers need to prepare their fields for sowing when the rain comes, and plough the land so that it can absorb the maximum amount of rainfall, for long storage. As a result, the working calendar of farmers is very tight with plowing, sowing, planting and harvesting. If the rain comes late, the farmers have to plough until the rain comes in order to ensure their land has no weeds, but on the other hand if the rain comes too early, they do not have enough time to prepare the land. To ensure fruitful production from *Ya* farming, regular and appropriate rainfall is essential, along with favorable sunshine. There is a saying in Burmese that goes '*a nyar thar, ta moe loe hnit mawe*', meaning that a dry land people can be poor after just one drought.

### **4. Vulnerability process: Environmental factor**

#### **a. Periodic drought**

The dry zone frequently experiences drought in which the rainfall level is noticeably below than that of normal years. Normally, annual rainfall is 29.5 inches (40 inches – 19 inches)) and rainy days ranges from 62 – 41 days per year (1967-19781 (Saw, 1990)). The study of U Saw Myint Tin (1990) states that 21% of the dry zone townships (54 townships) are affected by drought

every year (1967-1987), meaning that the probability of drought occurring in any given townships is once every five years and average total rainfall (inches) within (2001-2010) is as follows;

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Average
Average	19.33	29.57	20.69	26.66	23.63	38.08	20.79	20.67	16.01	29.04	26.7

Source : Meteorology and Hydrology Department, Pakokku Township

According to the above information, annual rainfall amount is less than previous two decades and the year with lower precipitation occurs frequently. Droughts mostly occur in the early monsoon period causing a shortage of soil moisture. This shortage of soil moisture can adversely affect crop productivity, such that agricultural and economic ‘droughts’ always follow a natural drought in an affected area. Particularly in the central dry zone area, drought years have significant adverse effects on the production of crops, leading to food shortages for both people and livestock in the region (Min, 1979 cited in Saw, 1990).

The recent drought happened at 2009. According to the findings from the interviews’ response, the year 2009 is the hottest period and also wild animals such as snake, gecko and rat naturally died. At every drought year, they face the shortage of fodder and they have to go other region about two or three days to get “the wild cactus” plants. People really feel dejection about the shortage of fodder. Weak and unhealthy cows and goats can’t resist to the shortage of food and water. So, herders have to sell the meat with cheaper price. So, at drought year, livestock breeders get noticeably adverse effect. But for people, they can manage their food by reducing the consumption rate of meals and quality of meals. Longer period of dry spell causes food deficiency of people and animals. Such a slow onset drought hazard has become the greatest threat to humanity (Blaikie et al. 2004). According to climate change scenarios conducted by the Meteorological Department, the drought hazard in the central dry zone area is likely to become more severe in the coming century (INC report, 2010). As a result, potential of threat in the central dry zone is at a high level.

### **b. Irregular Rainfall**

In recent decades, climatic fluctuations in the dry zone have become more intense, with droughts becoming more frequent and with rainfall patterns changing – arriving later in the early monsoon and leaving earlier in the late monsoon, and at the same time with rainfall becoming more intense (see in following chart).

Month	10 years (2000-2009)	2010	2011

	Day	Inches	Day	Inches	Day	Inches
Jan	0	0.09	0	0	0	0
Feb	0	0	0	0	0	0
Mar	0	0.02	0	0.04	2	0.2
Apr	1	0.33	2	0.99	2	1.54
May	6	0.35	3	1.42	8	5.91
Jun	6	2.9	5	1.03	5	1.73
Jul	9	1.83	6	3.62	4	1.7
Aug	8	3.67	15	6.09	11	14.42
Sep	8	5.11	6	1.78	6	3.12
Oct	7	5.16	15	13.3	9	11.94
Nov	1	0.67	0	0	0	0
Dec	1	0.19	2	0.71	0	0
<b>Average</b>	<b>47</b>	<b>20.32</b>	<b>54</b>	<b>28.98</b>	<b>47</b>	<b>40.56</b>

Source : Meteorology and Hydrology Department, Pakkkku Township

Even though they know it is very risky, farmers have tended to grow their crops as per usual under this climatic uncertainty, as agriculture is their main source of income. Especially in the early cropping season, they need to grow again if the first crop suffers from lack of rain and dies, to ensure a final harvest, but the net yield from their crops is generally unsatisfactory because of the accumulated amount of investment needed during the cropping season,

As an alternative, some farmers change to crop varieties with a shorter growing period; for example, pulses (green gram and pigeon) are now grown more intensively, instead of cereal and oil crop (sesame). Pulses can endure a shorter wet period and can be harvested after just one month. Previously, these crops were grown just for household consumption and for animal feed, but nowadays, these crops have become cash crops and are cultivated extensively. In general, quick and early ripening varieties require more intensive labor, so households with access to only a few laborers can gain only low profit levels.

Crops grown at rain-fed cultivation need the rhythm of rain and sunshine. If the rain comes in flowering period, flowers fall down and produce lower crop productivity. If the rain falls near harvesting period, the seeds are affected by diseases and could not produce the quality seeds which directly affect its price. As all of the agricultural works have to be done by labor forces, farmers who have insufficient labors frequently face the crop damaged because of the irregular rain during harvesting period. Thus, rain-fed cultivators suffer from these very high risks for their successful crop production under the irregular rain fall.

### c. Pest Interference

Pest interference is also the significant one of climate change impacts, which has become serious over the last five or six years. For example, the new cash crop 'green gram' is rather prone to pests and diseases, so farmers have to use a variety of pesticides at every cropping stage. To be free from pest interference and produce the quality crops, farmers have to use pesticide 3 times; sowing, flowering and fruiting period for pulses. However, farmers don't have any education program for pesticide usage except from the marketing program from Pesticide Company and thus, this favors to be misuse of pesticide. If pesticide feeding procedure is wrong, all investment will be waste and will go into less or no seed production. Actually, pesticide

feeding is very costly and takes 25% of cropping expenditure per year. Although the farmers put in much efforts and significant investment, the income from this crop is only enough to cover labor charges and food expenses during the cropping season, and the maximum income only covers one year's expenses for a household. Such short-term crop management practices, using pesticides and chemical fertilizers, have had increasingly irreversible impacts on the future productivity of the land.

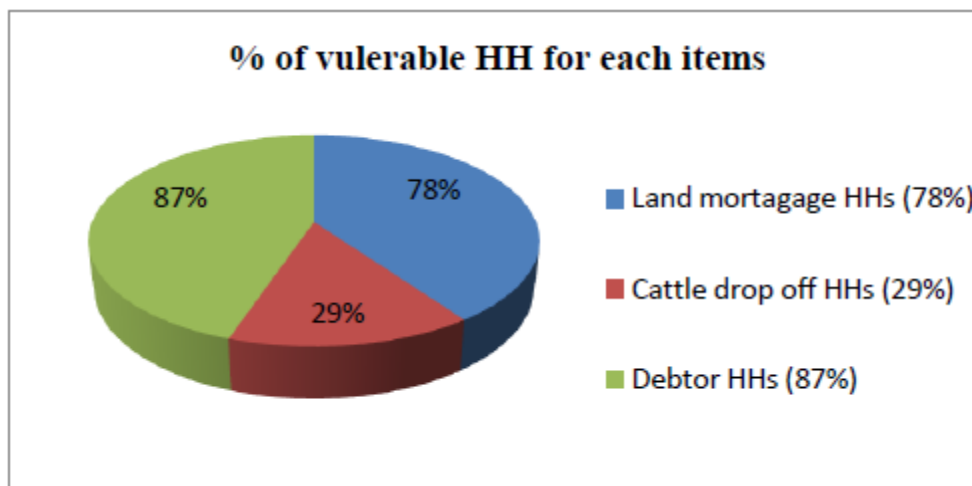
## **5. Vulnerability process: Socio-economic factor**

### **a. Unproductive response to environmental threat**

As mentioned above, the lower incomes from agricultural work have threatened farmers' livelihood security and forced them to depend on different income sources for their survival. Normally, the farmers rely on kinship relationships in order to borrow money or use in-kind arrangements for their household consumption. Because of the frequent troublesome years, the number of households who support their relatives decreases, such that many households are operating near the margins of subsistence (Scoones, 1998) and they sell their assets what they have accumulated throughout their life time. Another common way of solving their livelihood problems in the research village is land mortgage, called 'Myay Paung', where 'Myay' means land and 'Paung' means mortgage. When farmers borrow money from a moneylender, they transfer their use rights to the moneylender for the sake of interest (Anna, 1987). The moneylenders can then use the land until they receive back their loan. In some cases, if the landowners are unable to pay back their loan, they need to decide whether they will extend the land lease period or sell their land. Through this way, farmers give up productive assets and gradually reduce the land holdings, which are prerequisite for the survival of their young generation.

Some farmers also make money from exchanging cattle; in local terms called paun-tha-hli , in which cattle owner creates money from exchanging draught cattle to small cattle or some farmers totally sell the cattle without buying any cattle again. Actually, cattle are main driving force for dry zone agricultural work. From these solutions, many farmers lose their productive assets. The liquidation of productive assets such as seeds, cattle or ploughs, limits future productivity and livelihood sustainability (Start and Johnson, 2004).

If people need money urgently or have no assets to sell, they have to borrow money with a high interest rate. But mostly, some farmers cannot help pay back their interests for yield from crop production is merely enough for their household consumption at most. As a result, the amount of interest to be paid gradually rises and leads to the poorer farmers being overwhelmed with debt and causes poorer framers more pore. When the households are exposed to such shocks and stresses, and have less capacity to cope, they gradually become impoverished and very vulnerable. Here is the findings from the case study area(Mon Nyin village).



### **b. Insufficient loan**

Because of frequent experience on lower crop production, the crop yield is only enough for labor charges and food expense during cropping season or, in maximum, just to cover for one year food expense. Even the middle class farmers could not save the seeds for next year growing season. Moreover, current irregular rainfall pattern cause farmers to grow crop for one or more times as trial. That means they need more investment for growing. Although the better off farmers can handle the risks, the rest (especially about 50%) have to depend on other persons' help in term of borrowing money for next time growing.

Although the Myanmar Agricultural Development Bank (MADB) implements the Rural Credit Schemes for farmers to borrow money for growing crops and the loans are given at concessional interest rates to farmers for different cultivation season, the amount is limited according to the no. of land holding acre, but the maximum amount for ya-farmer per one cropping season is only one lakh (100,000 kyats ~ 125 USD). According to statical information from agricultural department, the growing investment for groundnut and sesame costs about 238250 kyat (298 USD), 147710 kyat (185 USD) per acre respectively and so farmers need sufficient investment for agricultural work. Actually, loans from the agricultural bank doesn't cover expense enough even for one acre. Moreover, the bank recollects this loan after 9 months in every year, ignorance of whether crop production fails or succeeds. If the crop fails, farmers have to borrow money (with interest rate) to pay back this loan in time. Another source of loan possibility is from Pesticide Company. The company contacts with local dealers and give the stock in advance. Farmers have to pay the costs with 5% interest rate after crop harvesting. This is not also supportive for the livelihood of farmers in the long term condition. So, it is clear that current supportive facilities from the Government and private companies for the farmers are not the practical solutions to solve the farmers' debt cycle.

### **c. Limited skill and resource for alternative income opportunities**

Actually, farmers in the study village depend solely on agricultural work. According to field observation, the soil fertility of cropping land at this village is generally good. If the weather is favorable condition, the crop production is enough for the annual household's expenses. There is saying "myay su lu ah" that means the fertile soil makes the people being less adventure. The elder villagers unsatisfactorily mentioned that the villagers in that village less prefer to try any other jobs or afraid to go another place as we used to do the agricultural work traditionally.

However, climate change effects force them to change their works to other income opportunities because these effects cause inadequate return from their traditional agriculture.

On the other hand, governmental and non-governmental organizations don't support adequate facilities such as in-kind, cash and extension services to enhance adaptive capacity for agricultural development. So, they become more interested in seasonal or oversea migration. About 15% of households migrate to other townships for job opportunities. 30% of better-off farmers make their money through diversified other income activities inside or outside the village because they are able to invest in these activities. Small farmers who have enough labor tend to extend their income source by making partnership with livestock breeders. As they haven't enough money, they have to find the ( mhway -phat ) person who own the herds. They have to give labor effort in raising other persons' livestock so that they possess 50% of new babies. This livestock becomes their source of income and they can sell whenever they need. However, majority of household still works in agricultural job as usual. Moreover, to get extra income, they sell the trees at their land or burn these trees to make charcoal. The landless dig the roots of the dead trees and burn them to make charcoal for extra income during off-season. In reality, such kinds of work are unfriendly to dry land environment especially in the research area. The reasons are that from their ancestors until now, they have been focusing only on their traditional livelihood practice ignoring other income opportunities. Consequently, they have got only the inadequate knowledge and skill about other income activities and become lack of resources such as technical, human resource, network and other capitals etc. So, they dare not do other livelihood activities except agriculture and even though they have wills, they don't know how to start the new income activities. Facing with the environmental challenges then, they have to change their income activities rather than traditional practice. They become in an awkward position and they have to face these challenges with very limited skill and resources for their survival.

## 6. Vulnerable state

Because of the frequent impacts of natural hazards, farmers face livelihood insufficiencies. Their coping strategies are not sound enough to protect from falling into deeper debt. The current condition of households' financial constraints at research area is as follow.

<b>Financial status of farmer household</b>												
	April	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Good Year		1					2					
Bad Year	1						2					1
<p>Note "1" Period of financial constraint before first cropping season</p> <p>"2" Period of financial constraint before second cropping season</p>												

Source; Result of focus group meeting

The month bolded represents the period of financial difficulties. First period is during the early cropping season. At that period, they haven't any crops left to sell, but they need to expense for labor charges or daily survival. So, they have to find money until before the harvesting period of August. If the crop production is successful, they could pay back the borrowed money after



selling the crops, otherwise they have to manage hardly to be enough the labor charges and food expense during the cropping season.

When it arrives second growing season, they need again cropping investment. After growing the crop, only few amount of money or no more money left at their hand. However, their expenditure is high because of contribution to others' social activities such as novice donation, weeding ceremony during that period. These demands also add to their financial burden. On the other hand, then they harvest the second crop, respective money lenders or any other persons who gave loans for agricultural materials, food items come and remind to pay money what they have to get. Farmers also try to allocate money to pay back, if possible, all of borrowed money. That prevents the accumulation of interest rate and also gets money lender's trust which is important for next time borrowing. If the second crop production is lower subsistence level (unsatisfactory), farmers have to make money for their daily survival and to cover next harvesting period. Through this track, farmers have to survive with livelihood insufficiency about the half of year. At previous year, farmers in the research village got serious impact of irregular heavy rain and their production is decreased half of normal. They are vulnerable to get upcoming impacts from of any forces. Being weak in terms of knowledge and adaptive capacity, the dry land people are thus helpless in the face of climate variability and its impacts (Mortimore, 2009).

## 7. Conclusion

This paper has explored the causal factors of farmer vulnerability under recent climate variability in dry zone area. It highlights the vulnerability process especially of rain-fed cultivators. The analysis of the progression of vulnerability of farmers is stated as the flow chart at the end.

In the dry land, the livelihood is determined by favor of climatic condition. Thus, climate change effects become rooted for farmer vulnerability. On top of that, low priority for government intervention is also the main root cause of farmer's vulnerability progression because they have low access to resource or any capacity development and awareness program that can enhance farmers' adaptive capacity. Even though farmers are unbearably affected by natural hazards, there is also not any awareness or development program form related organizations.

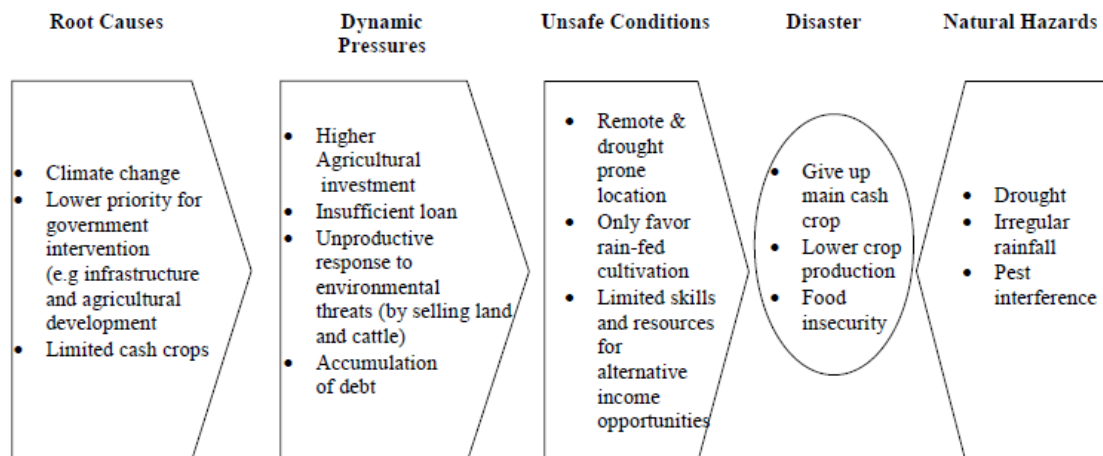
The region, dry zone itself is naturally prone to and hinders to get access to natural resources such as water, forest, soil and also spreads with hot and dry weather condition, which naturally blocks the accessibility of sufficient water or sound climate unlike other parts of Myanmar. Thus, dry land is physically unsecure for habitant and also favors only for the rain-fed cultivation. This kind of livelihood is also risky and unsafe under the irregular climatic impacts. To overcome this situation by the diversification of livelihood, necessary skills and resources are limited. This unsafe condition can easily transform into vulnerable state in relation to the different types of hazards.

On the other hand, the stress of insufficient loan for higher agricultural investment leads them to the life of thick debtor. As in return, selling the land or cattle for debt repayment or daily survival acts as the dynamic pressure and this process speeds up vulnerability of households who are in unsafe condition. The natural hazards tend to magnify the existing inequality of farmers along with initial state of well-beings.

In conclusion, farmers' vulnerability emerges from the complex nature of the environmental and socio- economic interaction. Although this paper focuses only on the vulnerability of the farmers for the specific small area, these issues are crucial for the consideration of dry zone agricultural development. This analysis based on the consideration of dry zone regional development, the primacy is basic software and hardware infrastructure development such as

implementation of water tube well, supporting agricultural tools, providing practical training, job creation or micro finance activity, etc. These kinds of development undermine the impacts of natural hazards and so the government should take into great account for the future economic development of our country through agriculture.

#### The Progression of Vulnerability of Farmers in Mon Nyin Village, Dry Zone Area



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