# Farmers' Perception and Adaptation to Drought in Maize Production, Dakrong District, Quang Tri Province, Vietnam

**Uy Tran Cao[1*] and Budsara Limnirankul[2]**

**ABSTRACT:** Drought is the most severe problem in Dakrong district, a rainfed highland area in Central of Vietnam. This climate phenomenon has been reducing more than 50% maize productivity every year in the area. This study was conducted with 180 farmers of three communes which having differences in terrain distribution and socio-economic characteristics of the district. This study assessed farmer' perception on drought and adaptation towards drought in maize production as a basis for the development of adaptation strategies later. The results revealed that through the assessment questions, almost farmers in the study area was classified as low to medium perception on drought (75%), especially, young farmer, ethnic minority, the poor or female groups had significant lower perception than others. In terms of adaptation, it partly reflected the relation between perception and adaptation when these above mentioned groups had low adaptation proportion in each adaptation measure. Besides, a significant percentage of farmers (23.33%) never applied any adaptation measures whilst, the rest of farmers adapted one or two practices and they mainly focused on "cultivating one season", "intercropping" and "changing to another crops". In conclusion, this study recommended that extension workers, local officers in charge of agriculture should pay attention on training and disseminating knowledge about drought as well as introducing coping measures for farmers, especially, the poor, ethnic minorities and women to increase their coping capacity. Moreover, figuring out the intercropping or rotating crops in accordance with maize, supporting resistant varieties, loans to develop irrigation system, etc. are very important solutions to cope with increasingly drought under the impact of climate change today.
**Keywords:** Maize, Drought, Perception, Adaptation, Adaptation measure.

## Introduction

Drought is considered be the most complex but least understood of all natural hazards, affecting more people than any other hazard (Wilhite, 2005). It defined as a temporary meteorological event, which stems from a deficiency of precipitation over an extended period of time compared to some long-term average conditions (Eriyagama et al., 2009), being one of the prime abiotic stresses in crops in the world. Crop failures and pasture losses are the two primary drivers of the direct economic impacts of drought in the agricultural sector (Kemper et al., 2012). Droughts continue to have significant impacts in both developed and developing countries. The latter still suffer from droughts the most (Wilhite, 2005) and Vietnam is one of those countries. Most regions in Vietnam, especially regions in the central to the south, were significantly affected by severe drought causing adverse impacts on livelihood and the national economy (Tinh, 2006).

Dakrong is a rainfed highland district of Quang Tri province where is located in a drought-prone area of Central Vietnam, considered as one of hottest areas in the country. The dry season last from April to August with the hottest daily temperature reaches 40 - 42$^0$C, and the rainfall is quite low, under 100mm per month (Quang Tri Hydro-meteorological Center, 2013). The combi-

[1] Center for Agricultural Research Systems, Faculty of Agriculture, Chiang Mai University, Thailand, 50200.
[2] Department of Agricultural Economics and Agricultural Extension, Faculty of Agriculture, Chiang Mai University, 50200.
* Corresponding author: trancaouy@gmail.com

nation of dry southwest monsoon has made the land was barren, water shortage, etc. that is why local people have perceived drought as the most severe climate hazard over the past years.

Maize is considered as an economically important cereal crop of the district, assumed a role second to rice in the farming sector and macro-economy of the region. However, under the influence of drought, maize production here is facing many difficulties. The limited awareness on drought of farmers (almost belongs to ethnic minorities who account for 82% population of the area) led to weakness in production adaptation, being the main cause of low productivity, low yield in maize production, etc. in the study area. This has contributed to creating the vicious cycle of poverty here. Therefore, the questions such as: (a) how are the farmers aware of drought that has been occurring every year in their habitat? (b) what are they coping strategy to drought in maize production? and its answers will contribute to clarify two objectives of this research, which are: (1) to assess farmers' perception on drought, and (2) to identify farmers' adaptations toward drought in maize cultivation activities.

The finding will contribute to understand the farmer's perception situation about drought in the study area which is the basis information for adaptive studies to assist maize farmers cope with droughts and climate change in the future.

## Materials and Methods

The above objectives both primary and secondary data were collected. The 180 households were selected randomly (from total household of 8,286) from three above communes.

Primary data were collected through key informant interviews (informal survey), focus group discussion (six focus groups with 13-15 farmers for each group, applied for male and female group farmers in three communes), and household survey (formal survey) with 180 heads of households, using semi-structured interview.

Both quantitative and qualitative type of information were gathered. Field observations were also included. Besides, secondary data such as rainfall, temperature, socio-economic data, etc. were collected from Hydro-meteorological Center, Statistics Department, Agriculture and Rural Development Department, Agricultural Extension Station, Local Government Offices to achieve better understanding of the drought phenomenon as well as maize production activities and farmer's adaptations in Dakrong district.

In respond to the first objective regarding to assess farmers' perception toward drought, farmers' knowledge was score by asking twenty questions (called *items*) relating to drought definition, experience of drought, drought memory and expectation of drought of the farmers (Taylor et al., 2009). Depend upon the number of correct answers of farmers, the total score across these items was calculated for each household. The class intervals were computed and divided into 3 class intervals (high, medium and low), following Harshbarger (1977) formula:

$$\text{Perception interval range} = \frac{\text{The highest score} - \text{the lowest score}}{\text{The number of intervals}}$$

By this way, the highest score that got from household interview was 37 and lowest score was 0, thus, farmers who had score from 0 to12 was ranked into low perception level, from 13 to 24

ranked in medium perception level and the rest of farmers ranked in high perception level.

The classification was meaningful in evaluating the level of perception of farmers regarding to drought. It also will be used as a predict variable in analyzing factors impact on adaptation of the farmers – one of another objective in this research.

Besides, one way ANOVA and descriptive statistics were also used to illustrate farmers' awareness in different communes or farmer's groups that would contribute to demonstrate a more comprehensive view of the farmer perception in study area.

In order to fulfill the second objective regarding the examining adaptation of farmers in maize cultivation, the primary data collected from household interview using questionnaire? was analyzed using descriptive statistics, frequency distributions, means and standard deviations. Especially, information from group discussions was very important in explaining adaptation options of farmers in maize production.

The data gathered from survey was processed and analyzed with quantitative and qualitative analysis technique. For the analysis Statistical Package for Social Sciences (SPSS) and Microsoft Excel were used.

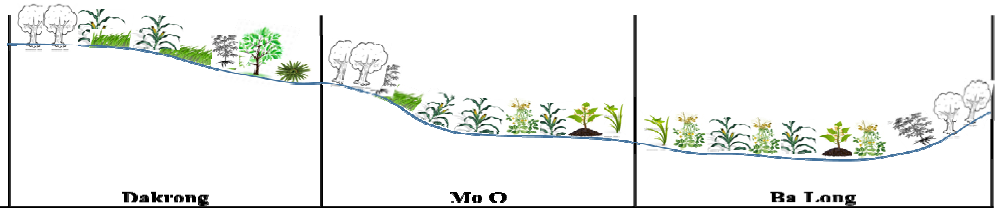
## Results and Discussion

### Characteristics of study area

Dakrong was known as a poorest district in Vietnam with the poor rate is nearly 35% (2012). The district had 14 communes, in which 90.9% of the population lived in rural area (of 39.159 people) with their life relying heavily upon 4.38% agricultural land area (of 122,444.64 hectares natural land area). Maize always occupied a significant land area of the district (around 30%) and being grown in all those communes (Dakrong's Statistic Department, 2013).

The research conducted in three communes in Dakrong district which represent three types of terrain distribution and socio-economic characteristics of the study area (**Table 1**). Mo O commune represented for medium terrain, having 73% ethnic minorities and 27% ethnic majorities who grew maize mainly in spring season on both the hills and flat land. Whilst, Darkrong represented for high terrain with 100% of the population was ethnic minorities where maize mainly grown on the hills in two season (spring and summer). Ba Long was exactly the opposite when 100% maize was grown at the flat land area, almost in the spring season by ethnic majorities. It can be said that this distinction would provide interesting differences in drought perception as well as adaptation capacity of maize growing households in the study area (**Table 1**).

**Table 1** Summary of topography and cropping in the study area.

| |   | | |
|---|---|---|---|
| - Main crop | - Maize,<br>- Upland rice,<br>- Cassava | - Maize,<br>- Rice (upland, paddy)<br>- Peanut and Cassava | - Maize,<br>- Peanut,<br>- Green bean. |
| - Maize area | 185 hectares (27.09% agricultural land area) | 60 hectares (23.48%) | 30.4hectares (32.48%) |
| - Maize season | - Spring season (Dec, Jan to Apr, May)<br>- Summer season (Apr, May to Aug, Sep) | - Spring season<br>- Summer season (little) | - Spring season |

Source: Group discussion and secondary data, 2013.

**Farmer's socio-economic characteristics**

Result showed that, the average age of the household's head was quite high (45.54 year old), (P value < 0.01). While the education level of these farmers was quite low, under 5 years in school. Dakrong commune with 100% the ethnic minority only 3 years in school (significant at 0.01 level) (**Table 2**).

**Table 2** Socio-economic characteristics of the farmers in the study area, N =180.

| Farmer's Characteristics | Unit | District | Commune | | | Sig. level |
|---|---|---|---|---|---|---|
| | | | Dakrong | Mo O | Ba Long | |
| Age | Year old | 44.54 | 39.63$^{c}$ | 44.30$^{b}$ | 49.68$^{a}$ | 0.000$^{***}$ |
| | | (12.53) | (11.83) | (13.85) | (9.66) | |
| Education | Year in school | 4.52 | 2.38$^{c}$ | 4.85$^{b}$ | 6.32$^{a}$ | 0.000$^{***}$ |
| | | (3.93) | (3.60) | (4.19) | (2.88) | |
| Gender distribution | % male | 60 | 53.3 | 61.7 | 65.0 | 0.405 |
| Household type | % poor | 31.1 | 50.0 | 33.3 | 10.0 | 0.000$^{***}$ |
| Ethnicity | % minority | 58.3 | 100.0 | 75.0 | 0.0 | 0.000$^{***}$ |
| Household income | 1,000 dongs | 27,188 | 19,347$^{b}$ | 23,038$^{b}$ | 39,181$^{a}$ | 0.000$^{***}$ |
| | | (17,26) | (11,31) | (10,07) | (21,18) | |

Source: Household survey, 2013.

$^{***}$ the difference among groups is significant at 0.01 level.

$^{a, b, c}$ the different letters show the significant difference between two groups at the 0.05 level.

Value in brackets is the Standard Deviation of Mean; 1 USD = 21,000 dongs.

The poverty rating was an important indicator in evaluating household's socioeconomic characteristics in Vietnam, under which rural household's monthly income per capita was below 400,000 dongs (equivalent 19.8 USD, 2013) would be classified as poor. On the results, the poverty rate of the study area was quite high, especially, in two ethnic minority communes (50% for Dakrong commune and 33.3% for Mo O). Ba Long where had highest annual household income (39 million dongs compare to 23 million dongs of Mo O and 19 million dongs of Dakrong), having lowest poverty rate (only 10%).

In terms of maize production, the farmers spent around 30% of their land area for growing maize (3.55 sao per household, 1 sao equivalent to 500$m^2$). Maize productivity in this area was quite low, especially, in drought years (around 145kg/sao in normal years and 66kg/sao in drought years) (Household survey, 2013). Although, maize was an important crop in household farming system in the study area, "the first objective" in maize production was quite different among communes, household types and other socio-economic characteristics of the households (**Figure 1**).

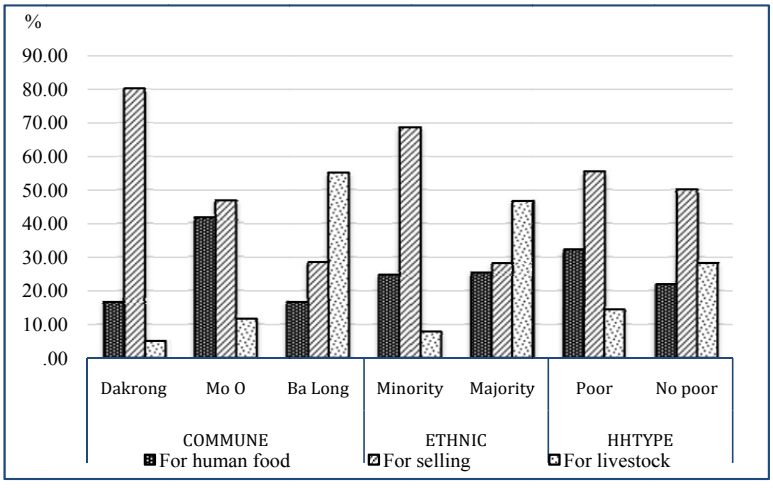



**Figure 1** The first objective in maize production of the farmers in Dakrong (%), N=180.

Source: Household survey, 2013

Majority of farmers in Dakrong commune (nearly 80%) grew maize for selling as the first objective whilst almost 60% of the farmers in Ba Long commune firstly used maize product for making bread. Mo O where farmers grew maize in both flat land and hill land had balance in food and selling objectives (around 40% household aimed to each objective). Similarly, a small percentage of the ethnic minorities and poor families used maize for producing bread as the first choice, but rather for food and selling. Especially, most of ethnic minority households (almost 70%) grew maize for market where they got cash to cover their difficult life.

### Farmer' perception on drought

Perception is one of important factors which may impact upon adaptation capacity. In the research, perception was compared between groups to see the difference in farmers' drought perception in a more multi-dimensional view. (**Table 3** and **Figure 2**).

**Table 3** Average perception score of farmers in the study area.

| Characteristics | N | Mean | Std. Deviation | Sig. level |
|---|---|---|---|---|
| *Perception score by Commune* | | | | |
| Dakrong | 60 | 17.18[b] | 7.51 | |
| Mo O | 60 | 17.85[b] | 6.26 | 0.000*** |
| Ba Long | 60 | 23.17[a] | 6.42 | |
| *Perception score by Age group* | | | | |
| <30 | 25 | 16.56[b] | 7.32 | |
| 30-50 | 95 | 19.21[ab] | 6.55 | 0.039** |
| >50 | 60 | 20.88[a] | 7.92 | |
| *Perception score by Gender* | | | | |
| Female | 72 | 18.17 | 6.78 | 0.061* |
| Male | 108 | 20.22 | 7.43 | |
| *Perception score by Ethnicity* | | | | |
| Minority | 105 | 16.78 | 6.72 | 0.000*** |
| Majority | 75 | 23.07 | 6.29 | |
| *Perception score by HHs type* | | | | |
| Poor | 56 | 16.45 | 6.36 | 0.000*** |
| No poor | 124 | 20.73 | 7.22 | |
| **Total** | **180** | **19.4** | **7.23** | |

Source: Household survey, 2013.

***, **, * the difference among groups is significant at 0.01, 0.05 and 0.1 level, respectively.

a, b, c the different letters show the significant difference between two groups at the 0.05 level.

The results has showed that, the majority of farmers' drought perception were medium level with average score was from 16 to 20 (score), accounted from 50 to 60% for each group of farmers. The one way ANOVA analysis also showed that, there were significant differences in perception score among groups of farmers.

In comparison between communes, it can be seen that the farmers in Ba Long had better understanding about drought when their average perception score was 23.17, higher than farmers' in Mo O and Dakrong commune (around 17 score, P value < 0.01). And 40% farmers from Ba Long were ranked at the high level, almost three times higher than that in other communes. These differences were explained by almost all farmers in Ba Long, Kinh ethnic majorities, who had higher education level than Mo O and Dakrong farmers (almost Bru Van Kieu and Pako people – ethnic minorities). The comparison between ethnic groups in this figure also proved for this explanation.

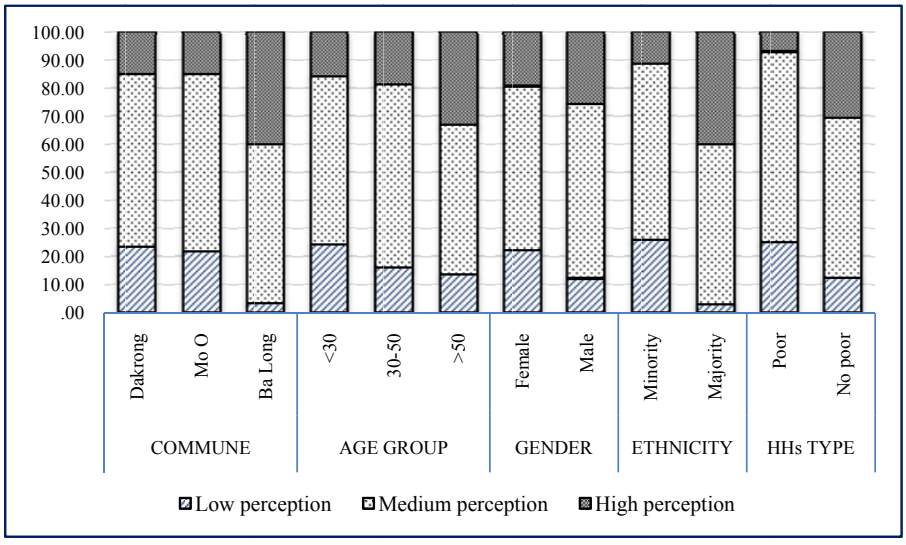



**Figure 2** Farmers' perception on drought in the study area (%), N=180.

Source: Household survey, 2013.

Gender and household type were considered as factors that can affect the difference in perception. The evidence was that, male heads of household had higher score perception than female ones (20.22 compared with 18.17 score, P value < 0.05) and 88% male farmers were in medium and high of level perception compared to 78% of female group. Similarly, the poor farmers had lower score as well as perception level than no poor farmers in the study area (P value < 0.01). The difference in perception between these groups came from the inequality in approaching information resources. Another results showed that, percentage of female and poor farmers participated in training course were only 38.9% and 35.7%, correspondingly which lower than male farmers' (43.5%) and no poor farmers' (44.4%). Besides, female and the poor also had less opportunity to participate in training or access to media such as TV, radio, etc. to expand their knowledge as well as their awareness. (Household survey, 2013).

One interested point in comparison drought perception between farmer groups that was the quite significant difference in age groups (P value < 0.05). It seemed that, awareness increased quite markedly with age. Thus, in a certain aspect of the relationship between age and perception might find that when farmers get older they had more experience and knowledge, and their perception could be accumulated from their own experience.

### Farmers' adaptation practices towards drought

In the focus group discussions, farmers gave 5 popular adaptation practices in the study area, which were: (1) changing showing day, (2) cultivating one season, (3) change to another crops, (4) planting the resistance varieties, and (5) intercropping. These measures were confirmed by the local professional staff, extension officers and agricultural officers before using to evaluate the adaptation level of surveyed households.

As from the results, a significance of farmers had never applied practice measures in maize production to cope with drought (**Figure 3**). Almost the rest of farmers chose one adaption (29.44%) or two adaptation (37.78%) measures in their farm practice to cope with drought. However, these options usually focused on "cultivating one season" solution (in Ba Long and Mo O commune) and "intercropping" solution (in Dakrong commune). Other options only applied by a small percentage of households (**Table 4**).

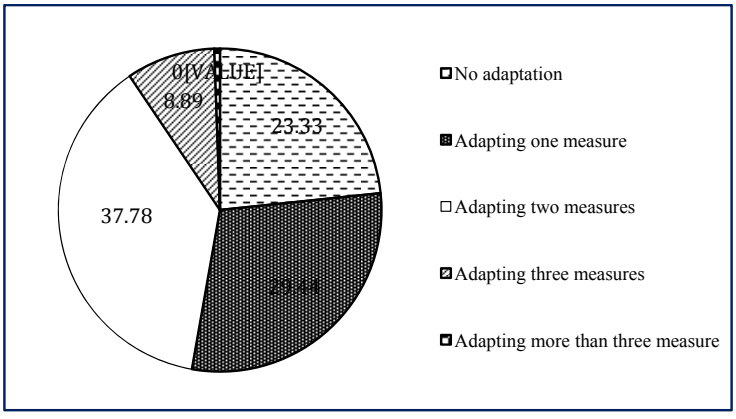



**Figure 3** Farmer adaptation practice levels in the study area (%), N=180.

Source: Household survey, 2013.

"Changing sowing day" was an autonomous adaptation when the farmers independently decided the sowing day depending upon their awareness about climate trends, temperature and rainfall at the beginning of each season. However, almost farmers did not apply this option as a main practice because according to farmer' ideas, the movement of season calendar should be considered by the effect of another climate phenomena in maize's growth periods or it must not affect the seasonality of the next crops. Thus, this adaptation option was not widely applied in the study area, and the difference in adapting among communities was not significant.

"Cultivating one season" seemed to be an important measure to cope with drought in the study area. There was a significant difference in this adaptation percentage between communes (P value < 0.01). It had become the first option with farmers in Ba Long (88.33% farmers were applying) and Mo O (58.33%), being the second option in Dakrong commune (25%). This practice was applied around fifteen years in Ba Long, seven year in Mo O and five year in Dakrong commune from group discussions. Farmers, under the encouragement of extension staffs, had changed from maize to green bean in the summer season. By this planned adaptation, the farmers reduced risks when green bean – a shorter day crop can avoid the severe drought in August. However, there were still many households, especially, in Dakrong and Mo O commune did not apply this measure. The non-adoption farmers explained that they had not known any suitable crops for next season (after maize) and they also wanted to grow maize two seasons to ensure their human food demand during the year.

"Changing to another crops" was assessed as a new efficient option of farmers in the study area. This adaptation was the result of autonomous and planned adaptation. Farmers, especially, in Ba Long commune perceived the damage from drought, trying to change from maize to chili (2001), sesame (2004), etc. However, these change had not brought the efficiency until they received consultation from Agricultural department to change from maize to peanut and cassava since 2007 in Ba Long commune and 2010 in Dakrong and Mo O commune (Group discussion, 2013). As the results, there was 40% and 21.67% of farmers in Ba Long and Mo O commune changed from maize to peanut and cassava whilst 10.00% farmers in Dakrong changed to cassava (P value < 0.01). However, a significant percentage of farmers, especially, in Dakrong commune did not apply this practice. They gave the idea that, maize still had been an important crop in each household in terms of food supply and feed for animals, thus, the changing was impossible.

**Table 4** Farmer practice in maize production (%).

| Adaptation practices | COMMUNE | | | TOTAL | Significant level |
|---|---|---|---|---|---|
| | Dakrong | Mo O | Ba Long | | |
| | (N = 60) | (N = 60) | (N = 60) | (N = 180) | |
| By changing sowing day | 10.00 | 11.67 | 21.67 | 14.44 | 0.145 |
| By cultivating one season | 25.00 | **58.33** | **88.33** | **57.22** | 0.000*** |
| By changing to another crops | 10.00 | 21.67 | **40.00** | 23.89 | 0.001*** |
| By planting the resistance varieties | 8.33 | 6.67 | 26.67 | 13.89 | 0.002*** |
| By intercropping | **43.33** | 11.67 | 16.67 | 23.89 | 0.000*** |
| By other measures | 0.00 | 1.67 | 0.00 | 0.56 | 0.366 |

Source: Household survey, 2013.

*** the difference between communes are significant at Chi-square 0.01 level.

"Planning the resistance varieties" was a new measure which applied by farmers since 2008. The government supported maize seeds for the poverty with the amount of 2 kilogram per households per year. By this way, local varieties was changed to new varieties such as VN10, LNS222, ML202, DK888, etc. which could resist drought and giving high productivity (Group discussion, 2013). Obviously, this planned adaptation contributed to increase coping capacity for maize farmers. However, the support was only for the poverty farmers, the others had to buy seeds of those varieties from seed companies which was more expensive and not readily available. This was the limitation for farmers applying new varieties extensively.

The last but not less important in drought adaptation in the study area that was "intercropping". This measure was very important in Dakrong commune where had 43.33% of farmers applied it as autonomous adaption to cope with drought. The fact that, this measure was adapted many years ago since the farmers perceiving that the combination of maize and upland rice can

cope with drought's effects and ensuring food security. Whilst, a part of farmers in Mo O commune (11.67%) and Ba Long commune (23.89) was experimenting maize and peanut for intercropping practice to cope with drought after trainings of Agricultural department from 2011. This experiment was evaluated as a good measure when both maize and peanut gave stable productivity under impacts of drought. This measure also encouraged by Extension station in condition of drought occurring severe recent years and becoming planned adaptation measure in Dakrong district.

Besides, farmers in the study area also used some other practices such as watering, shading for maize, etc., however, they were not applied widely (under 1% of household applying).

## Conclusion and Recommendations

Results from the descriptive analysis of farmers interviewed revealed that the farmers were characterized by low education level, low income and low maize productivity. With regards to farmers' perception on drought, majority of the farmers were ranked in low and medium perception level. There were the differences in perception between groups of farmers, such as male and female, poor and no poor, ethnic majority and ethnic minority, etc. Farmers' adaptation level was found to be close ties with their socio-economic characteristics when farmers in richer commune having better adaptation than other communes'. The majority of the farmers were applying one or two practices in which, using cultivating one season, inter cropping and changing to another crops were the main options. Another adaptation measures were applied by a small percentage of households.

The study recommended that extension workers, local officers in charge of agriculture should pay attention on training and disseminating knowledge about drought as well as introducing coping measures for farmers to increase their coping capacity. Moreover, the local knowledge of success farmers also should be concern and disseminate in the community to other farmers can learn and apply by themselves. Farmers, especially, the poverty and women should be encouraged to increase their level of awareness by participating training courses, learning from extension communication channels, etc. In adaptation practice, researchers and extension workers need to figure out intercropping or rotating crops in accordance with maize, thereby ensuring food security for the poverty and ethnic minorities, and contribute to increase farm households' incomes. Besides, supporting resistant varieties, loans to develop irrigation system are very important solutions to cope with increasingly drought under the impact of climate change today.

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