Relationship of coping strategy with income by households of farmers cultivating dry land (A case study in food-insecure regency of East Sumba in East Nusa Tenggara)

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Abstract. East Sumba Regency is an area that does not grow enough food to support people’s demands, although the main source of income of the people is from agricultural sector. This article aims at identifying the relationship between coping strategy and income which is applied in the households of farmers cultivated dry land for their livelihood. The samples for this research included farmers in four villages situated in two sub-districts at risks of food shortage. The samples were taken using snowball sampling technique and the data were gathered using interview, observation and recording. Additional information was used to support the findings and crosschecking was carried out with related parties. Coping strategy was applied by the households of farmers cultivating dry land by managing food-crop farming with salome planting pattern. This pattern is one of local wisdoms in muddling through problems of meeting necessities of life. The other strategy is pig-raising, by using keeping pattern which is adapted to the availability of crops resulted from land cultivation and by looking for food source in the forest. This research found that the more households practiced the coping strategy, the more income there will be.

1. Introduction
Food-insecure area in East Sumba Regency in East Nusa Tenggara (ENT), is an area with limited infrastructures in agriculture and transportation. Households of farmers in this area have limited access to natural resources, particularly water irrigation, inadequate human resources, limited input of agriculture and farming and technology transformation [1]. This condition is similar to the result of study in Tanzania [2]. Rainfall commonly occur in East Sumba during January – April, while dry season lasts for eight months, causing the semi-arid region. The area spreads for 700,050 ha (63.65% of the total area of Sumba Island in East Nusa Tenggara Province). Around 40% of East Sumba is area with
steep hills. In the southern part of the regency lie fertile slopes, while the northern part covers savanna, rocky and infertile land [3]. Approximately 59% of the population work in agricultural sector.

Agricultural growth offers possibilities for reducing risks of food shortages at all levels, increasing overall supply of food, creating economic opportunities for vulnerable produce sufficient food at the national level, but it is a complex failure of households to access guaranteed sufficient food [4]. Agriculture is one of the most climate sensitive sectors because of its dependence on rain-fed cultivation [5]. Climate change adversely affects economy due to heavy dependence of the agricultural sector on rainfall. A decrease of rainfall and rise in temperature has been increasing the exposure of region to frequent drought [6].

Climate change and variability are likely to intensify drought and increase potential vulnerability of the communities to future climate change especially in the semi-arid regions [7], where crop production and livestock keeping are critically important to food security and rural livelihoods. Key impacts of climate change and climate variability on dryland agro-ecosystems include: 1) reductions in crop yields and agricultural productivity with subsequent threats to the food security of dryland countries, 2) more erratic rainfall patterns and difficulties in determining timings of sowing and harvesting, and the selection of suitable crops with varying durations, and 3) reduced availability of water in already water scarce regions coupled with extreme rainfall events with increased loss of water via run off, etc [8]. Moreover, drought also causes loss of cattle products [9].

Poverty, food insecurity, natural resource degradation and climate change are global problems, however, they impact dramatically on rural community living in dry land (Consultative Group of International Agriculture Research) [10]. Food commodity contributes higher to poverty line, compared to the other factors, including houses, clothes, education and health. Food Poverty Line refers to the value of minimum daily expense for food, equaling to 2,100 kilo calories per capita per day [11]. The poverty line of East Sumba shows increasing trend each year, while the number of poor population is stable (Figure 1).

![Figure 1. Poverty line and number of poor population in East Sumba. Data source: [3]](image-url)

Vulnerability to climatic change are highly correlated with poverty and living status of farmers determines their vulnerability to and adaptation with climatic changes. An increase in the frequency of climate related hazards could lead households to lower expected income which in turn can cause to fall below poverty threshold level [12]. Intensifying agricultural production reduces farmers’ dependency on rainfall but are still insufficient to reduce poverty and vulnerability [13]. This makes poor population proportion in East Sumba still above 25% of the total population (Figure 2).
Figure 2. Percentage of poor population in East Sumba. Data source: [2]

Households of farmers are faced with various limitations of natural resources, human resources and the ways to meet the need of food. The likelihood of food security increases when farmers increase agricultural output and have access to a piece of land on the irrigation project [4]. This can be done in the long term with a great commitment among state government, local government and other concerned parties to improve agricultural products. Farmers’ ability for short-term adaptation is important to be improved, and thus, identification of coping strategy applied in households of farmers in dry land for the continuity of their life needs to be done. This article aims at identifying coping strategy relationship with income which is applied in the households of farmers who cultivate dry land for their livelihood.

2. Research methods

2.1. Location and sample research
This research used an explanatory method to generate in-depth and contextual qualitative data. The research were a quantitative and qualitative study. Data were collected through in-depth interview, observation and recording. Interview was carried out with respondents to dig in-depth information. Questionnaires were filled out by the researchers, at the same time with the interview. Observation was done by spotting the research object directly and the data obtained took the forms of field notes.

East Sumba is one of regencies in East Nusa Tenggara province which are vulnerable to food-shortage. The research samples were two sub-districts, namely Ngaha Ori Angu and Kambata Mapambuhang, which were vulnerable to food-shortage and accessible, if compared to the other sub-districts. Two villages in each sub-district were taken purposively as the samples. The villages included Pulu Panjang and Tana Tuku in Ngaha Ori Angu and Luku Wingir and Waimbidi in Kambata Mapambuhang.

Population in this research were farmers cultivating their dry land in food-insecure areas. Samples were taken using purposive sampling method by considering certain criteria. The samples were farmers who were able to answer the questions and to maintain communication with the researchers. The samples were gathered using purposive and snowball sampling. This study used a total of 80 respondents, with 20 farmers from each village.

2.2. Data analysis
Descriptive data analysis was carried out with coping strategy in meeting food and generating income. Coping strategies refer primarily to short-term actions taken to counteract the direct negative impacts of climate variability, including drought [14,15], to enhance food security. These strategies are measured using coping indexes. The coping strategy indexes in this study were modified from those proposed by Maxwell et al. [16]. The coping strategies were used for one year. Households in the study area were
those with limited income so that the researchers did not weight the choice of coping strategies applied. Based on the modification, the coping strategy indexes could be constructed, as presented in Table 1.

**Table 1. Coping strategy categories**

| Coping strategy index | Coping choice | Coping category |
|-----------------------|---------------|-----------------|
| 0                     | 0             | Did not apply coping strategy |
| 1                     | 1 – 3         | Low             |
| 2                     | 4 – 6         | Medium          |
| 3                     | 7 – 9         | High            |

Data source: Primary data analysis, 2019

Further descriptive analysis was performed to determine the relationship between the coping strategy index and income of dryland farmer households. Farmer household income for one year was calculated.

3. Results and discussion

Households of farmers cultivating dry land in this study practice several coping strategies. However, the strategies applied depend on local social, economic and cultural characteristics. Among all strategies, they set priority on food vulnerability for their households [17]. Indigenous drought coping strategies are complex series of actions taken both at the community and individual household levels aimed at maintaining a viable balance between losing assets and ensuring survival. Coping strategies reflect local resource base, vulnerability to drought stress, environmental adversity, past experiences and external resources that may be negotiated [18].

The coping strategies are applied by households of farmers in cultivating dryland for their livelihood in food-insecure areas (Table 2). Table 2 demonstrates nine coping strategies carried out by farmer households in food-insecure areas, East Sumba Regency. The food-security of farmer households is worsening, prompting them to apply more coping strategies to improve their food security.

**Table 2. Coping strategies applied by farmer households in achieving food security in food-insecure areas of East Sumba**

| Coping strategies                                      | Percentage of farmer households performing coping strategies (%) |
|--------------------------------------------------------|---------------------------------------------------------------|
| Mix cropping food crops                                | 100.00                                                        |
| Managing food reserve/yield                            | 100.00                                                        |
| Utilizing food available in the environment            | 100.00                                                        |
| Setting priority in food consumption                   | 100.00                                                        |
| Integrating agriculture and livestock                  | 87.50                                                         |
| Spending all savings                                   | 82.50                                                         |
| Taking the advantage of rice for the poor program      | 61.25                                                         |
| Applying loan                                          | 43.75                                                         |
| Migrating                                              | 30.00                                                         |
| **Average**                                            | **78.33**                                                     |

Data source: Primary data analysis, 2019

3.1. Coping strategy

3.1.1. **Mix cropping of food crops.** The common agricultural adaptation strategies used by farmers are the use of drought-resistant varieties of crops [19,6], crop diversification [5,20,2,22], mixed cropping [23], agro-forestry [24] and zero tillage. Moreover, input of food crop cultivation is used based on the condition of the households. Corns and “gogo” (dry land rice) are local varieties that are resistant to drought. Both of these varieties have a planting age of approximately 5-6 months. The seeds of both varieties are usually derived from yields in previous harvests. In the study area, if the planted corns or rice belong to hybrid varieties, the yields are not as good as the yields of local varieties. This condition
is likely because hybrid varieties require balanced fertilization and crop care, but farmers are unable to provide balanced fertilizer. Crop failures often occur in East Sumba, therefore farmers plant a variety of crops to anticipate the condition. In general, farmers combine crop diversification with mixed cropping. Mixed cropping involves growing two or more crops in proximity in the same field, sowing and using different maturing crop varieties [25]. In the beginning of rainy season, farmers grow three types of plants by putting three seeds in the same hole, namely corn, bean and pumpkin seeds. These seeds have different harvesting age and this type of planting can anticipate crop failure because there at least remains one seed living if one or two seeds die or cannot survive due to pests and diseases. This is a local wisdom in managing farming, which is so-called “salome” applied by the local people.

Home gardens are used by farmer households to meet food needs, especially vegetables. Home gardens with tree-based systems and livestock were reported by the farmers in the interview as one important 'safety net' when crops failed [26]. Papaya, pumpkin and cassava are found around the home gardens because the leaves are used as daily vegetables. Few moringa plants, which are famous for their leaves, are also found in this area. Vegetables which are usually planted in dry season such as spinach, mustard and peanut [13] are grown alongside river bodies [27]. The fertile soil along the river bodies is intensified for use by farmers although the planting location can only be reached by footpath and the distance is approximately 5-7 km from house.

Limited capital that the farmer households have puts effect on the minimum use of agricultural inputs. Although, in fact, the utilization of agricultural inputs is highly significant in food crop cultivation. Adjustment in agricultural inputs [9] is done by farmers using the resources they have such as seeds from their own production, livestock manure and family labor. Burning of residue is also done to ease cultivation and is considered a way of controlling crop pests such as stalk borer [28].

Minimum tillage and zero tillage are generally used by farmer households in food-crop cultivation. This speeds up the work and catches up to the beginning of planting because of the uncertain onset of rainy season. In addition, this is done for land conservation.

3.1.2. Storing yields management. Farmer households are subsystem farmers who prioritize meeting basic needs from their own production. They save the harvest [29] which is used for consumption for a year or until the next harvest season comes. In general, farmer households manage their food reserves well. Farmers use FIFO (first in, first out) and consider the need for food for a year as well as seeds for future planting. Most farmers can only grow corn and upland rice once a year. Based on their experience, planting corn in the second planting season has a higher risk of crop failure. Dried corn that is stored is still in the cob and husk (klobot) so that it has a longer shelf life than shelled corn. Likewise, upland rice is still in the form of grain. Farmers will pick corn seeds and process paddy grain into rice before it is cooked.

3.1.3. Utilizing food available in the environment. Farmer households in the research area consume food, including staple foods, vegetables, and fruits, grow in their environment. This adaptation strategy is also applied by farmer households in Ethiopia and Northwest Balochistan in their daily diet [6,9]. Plants growing in their environment, as long as not toxic, are used as food for the farmer households in their diet. The utilization of food available in the farmer households environment instead of industrially-processed food proves that farmer households in the research area employ a local food system.

3.1.4. Setting priority in food consumption. Household expense is minimized for very important and urgent needs [30]. Household expenses for non-food, such as buying kerosene for lighting, firewood for cooking, clothing and home renovation, are not priority. Farmers prioritize meeting food consumption. Climate change in East Sumba results in water scarcity both for agricultural and domestic needs. Farmers minimize the use of water for domestic needs during dry season, namely bathing and defecating, washing clothes and both eating and cooking utensils. Purchasing and using water for drinking and cooking are given priority.
3.1.5. Integrating agriculture and livestock. Farmer households generally combine food crops, especially corns, with livestock [31]. Agricultural waste can be used as animal feed and livestock waste as fertilizer for food crops. However, only a small portion of livestock waste has been used by farmers as fertilizer. Pigs, goats, cows and chickens are raised in this area. Livestock and poultry are not put in cages but are left freely around the house. Farmers graze cows in savanna. This practice of combining livestock and poultry is similar to the practice in most agriculture-dependent rural African households, in which livestock represents wealth and serves as an important insurance mechanism because households can sell animals to buy grain [32,6]. Livestock and poultry are food sources, source of income, form of insurance, source of fertilizer and symbols of public welfare [33].

3.1.6. Spending all savings. Farmer household savings are generally in the forms of livestock and poultry which are relatively sold easily and cash can be obtained in a relatively short time [34]. Savings in the form of cash, bank investment and jewelry are rarely owned by farm households because of the low income. They will sell livestock and poultry if they are forced to.

3.1.7. Implementing the program of “Raskin” or “rice for the poor”. The "Raskin" or "rice for the poor" program [35] is intended for every poor household by giving them 10 kg of rice per month [36]. Most of the dry-land farmer households in East Sumba receive rice every three months. The Raskin program is very helpful for farm households to meet their basic food needs.

3.1.8. Borrowing or applying loan. Farmers borrow crops and money for meeting their food needs [9]. The economic condition of dry land farmer households in East Sumba is relatively the same, but if certain farmers need loans, other farmers will lend their money or crops when they extra stocks. Farmers usually pay the loan after harvesting.

3.1.9. Migrating. The necessities of life that must be fulfilled cause the family head and family members to migrate to other area to find work [24,9]. This is usually done during period of food shortage. They work as construction workers or carpenters. Some of their income are sent to family and some other is used for their living.

Table 3. Average household income of dryland farmers in food-insecure areas of East Sumba Regency

| Source of income                  | Average income (IDR/month) | %   |
|----------------------------------|----------------------------|-----|
| **Agriculture**                  |                            |     |
| a. Staple food crops             | 221,666.00                 | 15.99|
| b. Vegetables and fruits         | 33,319.00                  | 2.40 |
| c. Plantation crops              | 69,355.00                  | 5.00 |
| d. Livestock                     | 436,641.00                 | 31.50|
| **Non-agriculture**              | 347,850.00                 | 25.09|
| **Family Hope Program or Program** | 148,125.00                |     |
| **Keluara Harapan (PKH)**        |                            | 10.69|
| Remittances from family members  | 84,500.00                  | 6.10 |
| Rice for the poor program “raskin” | 44,713.00                  | 3.23 |
| **Total**                        | 1,386,169.00               | 100.00|
| Average income per capita        | 277,234.00                 |     |
| (IDR/month/person)               |                            |     |

Data source: Primary data analysis, 2019

Not all coping strategies identified are applied by farmer households. They combine two to five strategies in meeting the needs. Many households have limited access to the favored coping options due to a lack of skills, labor and/or capital [15]. We argue that coping is a distinct component of vulnerability and that understanding the dynamism of coping and vulnerability is critical to developing adaptation...
measures that support people as active agents [15]. These active agents are needed to provide examples and empower farmer households so that they can improve food security and escape from poverty.

### 3.2. Diversification of the source of income of farmer household

A farming pattern is applied by integrating food crops with livestock, both large and small livestock. Cows and horses are examples of large livestock, while pigs, goats, and dogs are examples of small livestock. Most of the farmer households raise pigs, with only a few raising chickens. The income of farmer households in the study area are sourced from agriculture, non-agriculture, government programs and remittances from family members (Table 3). The biggest income comes from livestock, and East Sumba is one of the livestock centers in East Nusa Tenggara.

Table 2 and Table 3 present that not all coping strategies can generate income. Food reserve management and loans are used to meet food availability of farmer households. Table 4 depicts the relationship between the coping strategy index and farmer household income. In general, low-income households take more coping strategies to reduce their consumption level [37].

**Table 4.** Average income of farmer household based on coping strategy index in a month

| Coping Strategy Index | Coping Strategy Implementation | Average Income (IDR) | Number of Farmer Household |
|-----------------------|--------------------------------|----------------------|---------------------------|
| 0                     | 0                              | -                    | -                         |
| 1                     | 1 – 3                           | -                    | -                         |
| 2                     | 4 – 6                           | 716,730              | 59                        |
| 3                     | 7 – 9                           | 2,292,823            | 21                        |

Data source: Primary data analysis, 2019

Table 4 demonstrates that farmer households apply and combine several coping strategies to generate income. The higher the index of the coping strategy, the greater the impact of the coping strategy on the income earned. Only about a quarter of the respondents have a coping strategy index of 3. The majority of the farm households in the research area have limited skills, economic conditions, use of natural resources, and technology, resulting in the least implementation of coping strategies. Farmer households with better human resources have wider range of coping strategies.

### 4. Conclusion

Dryland farmer households that live in food insecure areas are faced with situations of limited natural resources, human resources, technology and infrastructure. They must be able to survive in this unfavorable situation by making adjustments both in the short and long terms. Coping strategies that can be identified include agricultural activities, a combination of agriculture and animal husbandry, meeting consumption needs and ways to meet food consumption needs. The government must focus on development programs in increasing the productivity of agricultural products in the area, instead of carrying out charity programs. Finding this research is the more households that do the coping strategy, the more income there will be.

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