Strengthening Archipelago Food Security And Food Sovereignty in ENT – Indonesia

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Abstract: In the semi-arid archipelago region of East Nusa Tenggara (ENT), food security and sovereignty have been long discourse and challenge. During 2019, drought and recent locust invasive have deteriorated and destabilize food security in the region. The Pandemic Covid-19 affects inter-islands transportation, agribusiness and remittances that limit people’ access to food. This paper explores food crops diversity in the semi-arid region and how it can be managed to minimize impact of pandemic’ disruption. We critic the policy of “business scale” to be implemented in the mosaic and marginal environment and provides dialogue of “small but secure” grounded in the Indigenous Knowledge. “Development started from periphery” as a new paradigm in National development should also gain momentum in shaping agricultural development in archipelago, strengthening food security and sovereignty and limited or minimize escalating impact of pandemic. Limited access to the global food market during pandemic should be a good lesson learnt in promoting and developing indigenous/local food crops, keeping its diversity and conserving natural resources.

1. Introduction
East Nusa Tenggara (ENT) province is one of the archipelago provinces in Indonesia. ENT province consists of 1,192 islands which only 43 islands inhabited. There are 7 main islands such as Sumba, Flores, Timor, Alor, Rote, Lembata and Sabu [1]. These main Islands are connected with the mainly deep sea (Savu and Flores Sea). Inter-island products which mostly agriculture products carried through marine transport.

Within the marginal and dominant semi-arid environment, food availability and food security have long been discourse and challenge for the people settled in the region. Nevertheless, before the European visited the region, almost no report regarding food deficit of the region. It presumably that low human population during that time and people in the every Island were able to conserve and manage their native food crops availability for at least to fulfill their level of subsistence.

Contacts with foreign traders particularly with China ad Indian in 17th Century [2,3] Colonial traders in the beginning of 19th Century [4] and agricultural food programs that bias to rice and lowland/wetland area during independent era [5] have shifted and frame new adaptation of people in semi-arid area do farming and managing food crops resources. Until recently, agricultural food program policy is still bias to the so-called “National Food Policy” that covers main crops: rice, maize and soybean.
So far, almost no policy on how to explore and develop the specific characteristics of the people living in the Islands (archipelago) in managing natural resources and develop capacity for food security and resilience. Based on the Indonesian Regulation 26/2007 regarding Territory Management, Territory refers to the integrated geographical space with administrative or functional boundary; while Region refers to area which the main function for ecology or cultivation. Within this Regulation, an Island have not specially mentioned as a territory or regional development based.

The paper argue that previous and recent agricultural program/policies have weakening the capacity of local people settled in the Islands (archipelago) to manage their food crops resources and therefore strengthening their food security and sovereignty. The paper offers the strategy to be considered in strengthening food security and food sovereignty of the people living diverse zone agro ecosystem and in different Island in ENT archipelago. The paper organized as follow. After this Introduction, section Two discusses food status in ENT archipelago in the last 10 years. Section Three deals livestock based food status in ENT. Based on the previous sections, section Four deals rethinking mainstream national food crops development and how it manage to suit specific condition in semi-arid archipelago region. The last section (Six) is Conclusion.

2. Materials and Methods
This research used literature studies, primary and secondary data. Primary data were taken from the Plant Genetic Resources study (PGR) in ENT. The PGR study was carried out by researchers in ENT-AIAT where the Authors involved. Exploration research employed for PGR study. Secondary data was used for food crop production, horticulture, inter-island crop distribution and livestock production.

3. Results and Discussion
3.1. Food Status of ENT in Archipelago Area Context
Food shortage or harvest failure is common or periodically problem in semi-arid areas [6,7] and therefore local people in the semi areas have developing their strategies to cope it by diversifying food crops, cultivate in more than a parcel of land, and develop food storage system/management. They also develops social systems to supports each others during famine seasons.

Food status in ENT is normally following the national standard which based on the rice paddystock/availability, and therefore during long drought and harvest failure for rice, food status becomes unsecure. Since the beginning of Indonesian Independent, food security or food self sufficient becomes the main priority in agricultural development and rice production becomes the main standard. Nevertheless, rice self-sufficient reached only during the 1984 and after then Indonesia have experiences rice deficit slightly and therefore fulfilled by rice import.

Government of NTT et. al [8] showed that Poor people in ENT in 2009 concentrated in 6 districts such as East Sumba, West Sumba, Sumba Barat Daya (SBD), Middle Sumba, TTS and Rote Ndao. In the same year, there are there were 12 districts that poverty rate was higher than average provincial level. ENT recently is still considered as the province with the high food vulnerability status.

Ancients or indigenous food crops in semi-arid regions in ENT constitutes drought tolerant grains such as millet and fox tail (Setariaitalica) and wild root crops (Dioscorea sp.). Before the arrival of European in Timor, there were no reports regarding the food status or food deficit in ENT. It seems that indigenous crops and pristine ecosystem have provided enough food for population during that time. However, human population pressure and intensification of agriculture have contributed to the degradation of indigenous food crops.

Data base from Sumber Daya Genetik (SDG) or genetic resource of food crops from ENT showed that existing food crops resources dominated by rice and maize accessions and then followed by root crops accessions (Table 1). These crops have listed in Pendaftaran Varietas Tanaman (PVT) or crop variety registers and some crops have listed under government genetic crops protection (Pusat Perlindungan Varietas Tanaman dan Perizinan Pertanian or PPVTPP),
Agriculture Ministry. These local genetic food crops have important role in sustainable self-sufficiency, food diversification, increasing added value and the welfare of farmers in semi-arid region of ENT.

Although there are still several foods crops both domesticated and wild in semi-arid areas (Table 1), rice and maize are the most common respected food crops in traditional farming. Some local tribes still performs rituals in cultivating rice and maize. They consider rice and maize are more than simply a food crops, but rather a “goddess” who maintain the existence of human race. This practice is still performed in many parts of traditional farming system in South-East Asia particularly for sustainable agriculture and green development [9, 10].

Table 1. Database of Local Food Crops Listed at PVT.

| Year | Crop/s            | No. of Accession | District      | Listed (PVT)          |
|------|-------------------|------------------|---------------|-----------------------|
| 2016 | Fox tail          | 1                | Nagekeo       | Listed                |
| 2017 | White maize       | 1                | TTS           | Listed                |
|      | Banana            | 2                | TTS           | Listed                |
|      | Sorghum           | 1                | East Flores   | Listed                |
| 2018 | Local rice        | 21               | Southwest Sumba | Listed             |
| 2019 | Moringa           | 2                | ENT province  | Listed                |
|      | Kenari            | 1                | Alor          | Listed                |
|      | Along Aya rice    | 1                | Alor          | Listed                |
|      | Lango cassava     | 1                | Ende          | Listed                |
|      | Glutinous maize   | 1                | Nagekeo       | Listed                |
|      | Sesame            | 1                | Nagekeo       | Listed                |
|      | Taro              | 1                | Southwest Sumba | Listed          |
|      | Purple maize      | 1                | TTS           | Listed                |
|      | Pop corn          | 1                | TTU           | In the process to PPVTPP |
|      | Garlic            | 1                | TTU           | In the process to PPVTPP |
|      | Potatoes          | 1                | TTU           | In the process to PPVTPP |
|      | Red bean          | 1                | TTU           | In the process to PPVTPP |
|      | Cassava           | 2                | Middle Sumba  | In the process to PPVTPP |
|      | Black Taro        | 1                | Middle Sumba  | In the process to PPVTPP |

Source: Database SDG (BPTP NTT) [11, 12, 13, 14]

Table 2 showed rice production concentrated in Flores Island (34%), while maize production concentrated in Timor Island (56%). Root crops (cassava and sweet potatoes) cultivated in all Districts, however it dominant planted in main Islands of Timor and Flores. Beans, particularly peanut and mungbean are widely planted in the areas which considered unfertile and low rainfall. These beans have been traditional crops that widely planted in the Rote and Sabu Island and in the northern part of East Sumba.
Table 2. Food Crops Production in ENT based on the Main Islands, 2015.

| Island  | Rice  | Corn  | Cassava | Sweet Potato | Peanuts | Mungbean |
|---------|-------|-------|---------|-------------|---------|----------|
|         | Ton   | %     | Ton     | %           | Ton     | %        |
| Sumba   | 192794| 20    | 139433  | 20          | 97914   | 15       |
| Timor   | 182760| 19    | 384010  | 56          | 236245  | 37       |
| Flores  | 471246| 50    | 114222  | 17          | 213731  | 34       |
| Others* | 101290| 11    | 47418   | 7           | 89425   | 14       |
| Total   | 948090| 100   | 685083  | 100         | 637315  | 100      |

Source: Tabulated from NTT Statistics [15]

*) Others: Alor, Lembata, Rote Ndao and Sabu Raijua Districts.

Rice mostly planted in the lowland areas of Western Flores (Manggarai) and in the coastal areas of Timor Island. Total land area for rice was only 3.5% from agricultural land in ENT and therefore with the current productivity (3 – 4 ton/ha), rice production have not meet the provincial demand for rice. Even in the areas dominated with rice field, almost no or very small surplus production is going to the market. Rice production is mostly for household consumption or petty commodity production for local market. This typical rice production is outline of farming in semi arid areas that countenance high risk in food crops production in general.

More than half of maize production in ENT existed in Timor Island. As a main staple food for majority people in Timor, almost all maize production in traditional farming in Timor keeps for household consumption. Beside Timor Island, maize is widely cultivated particularly in the dominant dry land areas in Eastern Flores and Lembata and Sabu Islands. Although there were slightly increases in terms of planting areas of maize farming, there have no significant changes in maize production and productivity in ENT in the last 10 years.

Root crops are very important food crops in semi-arid areas; however there are only two root crops (cassava and sweet potatoes) have taken into consideration in government agricultural program. Taro and *Diascorea* sp. have neglected in government programs, while for upland semi-arid farmers these root crops are important to substitute shortage of grains crops production.

Table 3. Horticulture Crop Production in ENT 2015-2018

| Year | Shallot | Garlic | Potato | Cabbage | Petsai | Chili | Pumpkin |
|------|---------|--------|--------|---------|--------|-------|---------|
| 2015 | 20,821  | 2,374  | 1,925  | 12,212  | 48,870 | 24,353| 102,283 |
| 2016 | 23,904  | 2,733  | 6,972  | 15,284  | 60,424 | 39,090| 146,411 |
| 2017 | 77,721  | 2,165  | 8,271  | 43,213  | 86,544 | 52,278| 253,791 |
| 2018 | 45,415  | 4,522  | 6,973  | 34,491  | 101,878| 52,474| 193,866 |

Source: NTT Statistics [17, 18, 19, 20]

Farmers in some parts of the Island of Timor, Sumba and Flores, Taro and *Xanthosomas agittifolius* are also important crops for food, feed and source of cash income. Among horticultural crops, red onion is the most volatile crop in terms of production. Nevertheless, government program intervention in the last five years have been impact in increasing red onion production and supply to market become stable. Shallot production leads to increases farmers’ income and improve welfare of rural dwellers [16]. Production of other horticultural crops have steady increases over time (Table 3), however it is quite volatile between seasons.
Inter-island trade of food commodities (Table 4) showed that ENT imported more food commodities than do export, particularly for main staple of rice. Rice imported increased drastically in 2018 and 2019 probably due long drought that leading to harvest failure of grains crops. This figure indicated also there was food shortage (rice) in ENT.

NTT Statistical data during 2005 – 2015 showed that major food crops in ENT productivity and production was stagnant around 400,000 – 500,000 ton (rice) and 500 - 700,000 (maize). In 2016 ENT did imported rice close to 30,000 tons and increased almost double (53,000 tons) in 2017. Surprisingly, in the next 2 years (2018 and 2019) ENT did imported rice increased sharply such as 695,000 and 280,000 tons respectively (Table 4). This figure probably has correlated with the long drought in ENT leading to harvest failure. Indeed, most rice filed in Timor failed to cultivated/planting failure during planting season 2019/2020 due to lack of rainfall. This rice import trend indicated also that local rice production system could not adaptable with changes in climate that implied local rice production does not meet with the market demand.

| Food Commodity | 2016 Domestic Out | 2016 Domestic In | 2017 Domestic Out | 2017 Domestic In | 2018 Domestic Out | 2018 Domestic In | 2019 Domestic Out | 2019 Domestic In |
|----------------|-------------------|------------------|-------------------|------------------|-------------------|------------------|-------------------|------------------|
| Rice (ton)     | 127               | 30,000           | 65                | 53,000           | 0.1               | 675,000          | 23                | 281,000          |
| Maize (Kg)     | 1,384,579         | 814,198          | 5,003             | 412,001          | 3,507             | 200,746          | 188,654           | 557,060          |
| Cassava        | 23                | -                | 9,565             | -                | -                 | -                | -                 | -                |
| Sweet potatoes | 10                | 29,500           | 80                | 21,150           | 3,000             | -                | 5,040             | -                |
| Mungbean       | 139,916           | 3,500            | 104,500           | 3,520            | 87,850            | -                | 114,450           | 11,500           |
| Peanut         | 909,512           | 500              | 604,448           | 19,000           | 654,490           | 18,250           | 665,840           | 20,350           |
| Shallot        | 262,261           | 151,510          | 64,450            | 304,985          | 394,779           | 67,201           | 1,405,725         | 172,020          |
| Garlic         | 16,200            | 462,550          | 950               | 1,016,000        | 1,350             | 936,150          | 8,160             | 1,814,843        |

Source: NTT Statistics [18, 19]

3.2. Perspective of Animal Based Food Status

Government Law No. 18/2012 regarding food security showed that: “it is situation which food available and fulfilled from the State level up to household/individual level by characterized quantity and quality, save, diverse, nutritious, equity and affordable, and it contradicted the religion and culture for productive, active and healthy life.” Intelligence and quality of the people have positive correlation with animal protein consumption. Animal protein cannot be replaced with other sources of protein.

Average protein consumption in Indonesia was only 5.1 gram/capita/day. This figure was far below from protein consumption in Developed Countries. Animal protein consumption in US had reached 70% from total consumption protein (http://www.poultryindonesia.com).

Animal source protein consumption in ENT have close related with the livestock population and diversity. Main livestock population in ENT 2015 – 2018 showed in Table 5. Livestock population is still chickens and pigs, nevertheless native chickens have negative growth while pigs have the highest positive growth. The growth of pig’s population has correlated with the high demand of pork while cattle produced mostly for inter-island trade.
Table 5. Livestock population in ENT 2015-2018

| Type         | 2015      | 2016      | 2017      | 2018      | Growth (%) |
|--------------|-----------|-----------|-----------|-----------|------------|
| Cattle       | 899.577   | 984.508   | 1,007.608 | 1,027.256 | 4.15       |
| Water Buffalo| 141.075   | 156.927   | 162.658   | 165.551   | 5.06       |
| Goat         | 626.431   | 637.969   | 674.227   | 693.577   | 3.61       |
| Horse        | 111.047   | 112.557   | 165.551   | 114.514   | 5.03       |
| Lamb         | 65.421    | 66.884    | 67.579    | 68.388    | 1.43       |
| Pig          | 1,812.449 | 1,845.408 | 2,073.446 | 2,141.246 | 6.17       |
| Native chicken| 10.585.385| 10.662.627| 10.362.140| 10.430.260| -0.73      |
| Duck         | 322.923   | 344.942   | 345.75    | 353.911   | 2.74       |
| ENT          | 2166.474  | 2303.787  | 1415.765  | 1395.941  | 27.46      |

Source: ENT Statistics [1]

Most rural farmers in ENT directly or in-directly depend on livestock as a main source of protein and household’ cash income. Livestock also play important roles both for socio-cultural of the people and regional economy. Almost 10% of GRDP is contributed from livestock and it dominant from beef cattle. Traditional livestock farming particularly for ruminant have use very low external input and therefore suits for smallholders and small farmers.

Although cattle exported from ENT province around 65,000 head annually and almost similar amount slaughtered for regional/provincial consumption, nutrition insecurity is still a big challenge of people in semi-arid region of ENT. Average percapita protein consumption in ENT was considered very low compared with national level such as 50 grams in 2003 (BPS, 2004) which still continue up to the present. Daily average consumption of Calorie (Kcal) and Protein (Grams) per-capita in urban area in ENT during September 2015 was 1971 Kcal and 57 gram which below average national level [17].

Since food crops production depends on the climate variability, livestock particularly ruminant animals and chicken becomes major source of animal protein for household. Nevertheless, forages limited the growth of ruminant animals in semi-arid areas. Good quality of cattle is normally for interisland trade and mostly to supply beef market in Jakarta, while low quality cattle for local market. People in rural areas mostly consume beef during or if there are socio-cultural events.

Pigs, small ruminants and chickens for small farmers in rural areas are important animals for household cash income source, socio-cultural propose and most importantly as main source of animal protein. The main constraint in livestock production in semi-arid areas is feed. As crop production limited by low and erratic rainfall, poor harvested crops have also limited production of pigs and pigs which normally compete for family consumption (food). Agriculture by products from maize and rice farming (rice straw) are only available for ruminant’s animals during or soon after harvest 1 – 2 months and absent for the rest long dry season.

Pigs and native chicken as main source of animal protein for household have fair distributed across districts (Table 6). Managing availability of these two animals in local level and or inter-island trade/distribution is very important to contribute in overcome nutritional food problems for households in semi-arid areas. Common ND diseases for chicken and recent Hoc-cholera and African Swine Fever (ASF) for pigs have deteriorated the availability and the market of these two commodities.
Table 6. Main Livestock Population in ENT 2018.

| District              | Cattle | Buffalo | Pig    | Goat | Native Chicken |
|-----------------------|--------|---------|--------|------|----------------|
| Kupang Municipality   | 6,323  | 27      | 32,672 | 6,632| 137,150        |
| Kupang                | 225,697| 1,836   | 418,075| 38,218| 2,124,532      |
| South Central Timor   | 194,401| 324     | 193,219| 26,295| 622,421        |
| North Central Timor   | 125,165| 743     | 71,776 | 38,888| 157,197        |
| Belu                  | 69,930 | 849     | 57,729 | 16,228| 267,763        |
| Malaka                | 78,298 | 478     | 93,191 | 19,701| 414,609        |
| West Sumba            | 1,596  | 12,768  | 55,724 | 2,765 | 167,126        |
| East Sumba            | 51,886 | 324     | 193,219| 26,295| 622,421        |
| Middle Sumba          | 8,055  | 9,254   | 44,458 | 10,677| 375,041        |
| Southwest Sumba       | 3,257  | 15,121  | 80,604 | 17,922| 237,993        |
| East Flores           | 2,478  | 13      | 103,204| 65,663| 583,199        |
| Sikka                 | 14,409 | 1,976   | 133,457| 56,309| 270,167        |
| Ende                  | 36,172 | 2,655   | 59,372 | 25,967| 2,039,770      |
| Ngada                 | 40,977 | 14,134  | 142,527| 26,170| 399,507        |
| Nagekeo               | 33,884 | 7,253   | 107,441| 46,939| 488,288        |
| Manggarai             | 25,307 | 7,822   | 39,430 | 11,295| 196,339        |
| East Manggarai        | 5,356  | 1,594   | 65,177 | 32,544| 285,381        |
| West Manggarai        | 14,846 | 18,614  | 39,855 | 6,586 | 112,965        |
| Alor                  | 9,970  | -       | 96,981 | 41,609| 346,821        |
| Lembata               | 4,850  | -       | 45,823 | 41,040| 220,164        |
| Rote Ndao             | 63,902 | 11,578  | 88,984 | 54,090| 124,542        |
| Sabu Raijua           | 5,497  | 10,399  | 46,847 | 50,506| 278,023        |
| East Nusa Tenggara    | 1,027,256| 165,551| 2,141,246| 693,577| 10,430,260      |

Source: NTT Statistics [20]

3.3. Rethinking Mainstream National Food Crops Development

3.3.1 Food Security and Food Sovereignty

The term food security is a concept that describes a condition regarding access to adequate food. Food security first introduced in the mid 1970s, a time of turmoil on global grain markets, rising hunger [21]. 1974 World Food Conference had set the right of every man to be free from the hunger and malnutrition [22] and then 1996 World Food Summit extend the term of “food security when all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life” [22]. Nevertheless, one of the important findings from the FAO’s assessment showed the target to decrease halve of undernourished people by 2015 have not achieved [23]

The term of food sovereignty is “a political agenda for how to address inadequate access to food and land rights” [21]. Food sovereignty emerged as response to the disappointment of food security which emphasize more on how to maximize food production and less taken into consideration on environment, local knowledge, how the food produced, where it comes from and by whom it was produced [24, 25]

By food security concept proposed in 1996 World Food Summit, food security problems in semi-arid area lies in marginal environment particularly low and erratic rainfall, human resource,
and government food policies (national and local level). Most people in semi-arid region can be grouped as food insecure due to low and erratic rain and therefore agricultural policy should be designed or adjusted with those shocks as [26] pointed out that: “solving the problem of food security require more than simply innovating to increase yields, but need changes in farming systems to promote the sustainable, and resilient production of food to meet the nutritional requirements of local and global populations”.

We argue that national food crops policy that bias to rice as staple has weakening food security of people living in semi-arid archipelago. It can be seen from the decreasing food crops diversity, food shortage and getting increases on dependence on imported rice; while some native food crops is going to be extinct if there is no practical solution to save it.

Using rice as standard for food security or food availability in the household level in semi-arid areas is a misleading concept. Rice production is the most unpredictable among grains crops in semi-arid areas due to uncertain rainfall. There were highly variations of rice production across regions/areas and across years/seasons. When water resources is one of the important factor in rice production and will be a major for agriculture in coming decades, there is a debate on social, economic and ecological issues of water management for crop production in semi-arid [27, 28].

To minimize rice import, local capacity/resources should be empowered. As water is very limited for wetland rice, dominated rain fed rice filed should be well utilized. So far, this rain fed is still underutilized mainly due to lack of water. By 215,000 ha rice field lands in ENT, only in Flores island can planting rice twice a year while the rest only once a year during rainy season. Indeed, more than half (50.28%) rice field in Timor and more than quarter (27.67%) rice field in Sumba were underutilized due to lack of water [18]. This figure showed that there is opportunity by improving current technology or rice farming management in semi-arid areas to overcome the food security problems.

Some food crops naturally grow around and in the forestland. Of most common wild food crops is Dioscorea sp. Farmers generally collecting those wild food crops as a buffer food stock and or during famine seasons. Fast decreasing forestland has negative impact to the diversity of wild food stock. It is also affects micro-climate, rainfall/water and other ecological functions. Therefore forest in the semi-arid forest should be protected without eliminating people access to collect native wild food stock. Local people should be play important part in protecting diversity wild food stocks.

By high risk of food crops production, particularly rice in semi-arid areas, it is not surprisingly that there is no insurance scheme to protect farmers from harvest failure. Government Law No. 19/201 regarding protecting and empowering farmers is difficult to implement for high risks food crops production. Therefore, the roles of Central and local government needed as guarantee for farmers to get insurance from crops failed to harvest.

3.3.2 Exploring and Developing Local Food Crops and Specific Location Discourse

Semi-arid area of ENT is rich with different kinds of food crops. In their research in 5 Districts of ENT province, Mundita [29] showed that those districts are rich in terms of alternatives food crops, particularly root crops group. Except rice and maize, those crops have not or less taken into account in government programs, while in facts those crops is very important for people in semi-arid areas to sustain food security in unpredictable climate environment.

AIAT research regarding food crops biodiversity in ENT have agronomic characteristics of food crops ranging from the roots, stems, leaves, flowers, fruit, pods, seeds, and tubers. Some species are going to be extinction and needs urgent management to be protected and conserved. Some crops have special roles for certain tribes not only for food, but also to maintain their culture. Therefore, as [30] pointed out that “since people are different, we should expect decisions about food sovereignty to be different in different contexts.”

Most of the region in ENT archipelago is considered as semi-arid region that differ with Western part of Indonesia. Consequently and as part of Wallacea, ENT comprises specific flora and fauna, some of them are considered as endemic and drought tolerant floristic elements [31]. It is considered
that local food crops in the every districts or specific ZAE are the food crops that suitable with the specific bio-physical and farmers’ preferences.

4. Conclusions
Semi-arid region on ENT is rich adaptive alternatives food crops that can be developed to strengthen food security and food sovereignty. Ancients or indigenous food crops in semi-arid regions in ENT constitutes drought tolerant grains such as millet and fox tail and wild root crops (Dioscorea sp.). Recent food crops that widely planted as staple and suitable for semi-arid areas are maize and sorghum.

Beside low and erratic rainfall, semi-arid area is also have highly variation in land and soil that require sophisticated knowledge to cultivated with suitable food crops and livestock. Therefore, local people in different places in semi-arid areas have developed specific adaptable food crops and livelihood strategies to cope with the harsh environment. Though several indigenous food crops still exists, rice and maize recently are the most common and widely cultivated food crops in traditional farming. Wild food crops, particularly Dioscorea sp. are still considered as buffer food stock.

Decentralization and devolution era should useful to encourage food security and food sovereignty. This requires local government commitment to manage and protect local food resources, develop small scale production for local market, embracing and improving traditional mixed cropping practices. Within the patchy and mosaic environment, concept of business scale should be adapted to suit specific circumstances of the people and environment.

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References
[1] BPS NTT 2018 Profil Sektor Pertanian Propinsi Nusa Tenggara Timur.
[2] Dampier, W 1939 A voyage to New Holland. London: Argonaut Press.
[3] Wallace, A R 1869 The Malay Archipelago: the land of the Orang-Utan and the bird of paradise. A narrative of travel, with studies of man and nature. London: Macmilland and Co.
[4] Hayami, Y 2003 An Ecological and hystorical perspective on agricultural development in Southeast Asia. In T Akiyama & D F Larson (Eds.), Rural Development and Agricultural Growth in Indonesia, the Philippines and Thailand (pp. 15 - 48). Canberra: Asia Pacific Press.
[5] Hoskins, J 1993 The play of time: Kodi Perspectives on calendars, and exchange Berkeley University of California Press. 1993.
[6] Omerling, F J 1957 The Timor Problem: a Geographical Interpretation of an Underdeveloped Island. Groningen: J B Wolters.
[7] Pemda NTT, Dewan Ketahanan Pangan, Kementrian Pertanian, & World Food Program 2010 Peta Ketahanan dan Kerentanan Pangan Nusa Tenggara Timur. Kupang: Pemerintah Provinsi Nusa Tenggara Timur, Dewan Ketahanan Pangan, Kementerian Pertanian and World Food Programme (WFP).
[8] Asouti, E & Fuller, D Q 2013 A contextual approach to the emergence of agriculture in southwest Asia: Reconstructing early neolithic plant-food production. Current Anthropology, 54 (53) 299-345.
[9] Ramkumar, A 2015 Rice, Risk and Ritual: What Agriculture and Religion Tell Us about State-Minority Relations among the Khmu of Northern Laos. *Journal for Undergraduate Ethnography*, 5 (2).

[10] Database SDG 2016 *Laporan Akhir Kegiatan SDG BPTP NTT*.

[11] Database SDG 2017 *Laporan Akhir Kegiatan SDG BPTP NTT*.

[12] Database SDG 2018 *Laporan Akhir Kegiatan SDG BPTP NTT*.

[13] Database SDG 2019 *Laporan Akhir Kegiatan SDG BPTP NTT*.

[14] BPS - Statistics Indonesia 2015 *Konsumsi Kalori dan Protein Penduduk Indonesia dan Propinsi (Consumption of Calorie and Protein of Indonesia and Province)*.

[15] deRosari, B & Ngongo, Y 2019 Inducing Agricultural Innovation for Poverty Alleviation: Case of Shallot Program in East Nusa Tenggara Province. *Paper presented at International Seminar on Rural Sociology and Community Development, Mataram 20 – 23 November 2019*.

[16] BPS NTT 2015 *Profil Sektor Pertanian Propinsi Nusa Tenggara Timur*.

[17] BPS NTT 2016 *Profil Sektor Pertanian Propinsi Nusa Tenggara Timur*.

[18] BPS NTT 2017 *Profil Sektor Pertanian Propinsi Nusa Tenggara Timur*.

[19] BPS NTT 2019 *Profil Sektor Pertanian Propinsi Nusa Tenggara Timur*.

[20] Clapp, J 2015 Food Security and Food Sovereignty: Getting past the Binary. *Dialogues in Human Geography* 4 (2), 201 - 211.

[21] FAO 1996 World Food Summit 1996. doi:http://www.fao.org/3/x2051e/x2051e00.htm

[22] Bruijnsma, J 2017 *World Agriculture: Towards 2015/2030: An FAO Study*: Taylor and Francis Inc.

[23] Gordillo, G & Jeronimo, O M 2013. *Food Security and Food Sovereignty (Base Document for Discussion)*. Rome: FAO.

[24] Hannah, W 2011 Food Sovereignty: A New Rights Framework for Food and Nature? . *Environment and Society: Advances in Research*. 2 87 - 105.

[25] Benton, T G 2016 *Food Security. In Encyclopedia of Applied Plant Sciences* (2): Elsevier Inc.

[26] Blanco-Gutiérrez I, Varela-Ortega C & Purkey D R 2013 Integrated assessment of policy interventions for promoting sustainable irrigation in semi-arid environments: A hydro-economic modeling approach. *Journal of Environmental Management*, 128, 144-160.

[27] Sidibe, Y Ellis, T Katic, P G, Mul, M Sei, K b E Sei, M J et al. 2013 Rice in Southeast Asia: facing risks and vulnerabilities to respond to climate change. *Agricultural Water Management*, 5(2), 325-328.

[28] Mundita, I W 2013 *Pemetaan Pangan Lokal di pulau Sabu-Rajiu, Rote Ndao, Lembata, dan Daratan Timor Barat (Kabupaten Kupang dan TTS)*. Kupang: Penerbit PIKUL Kupang.

[29] Grey, S & Patel, R 2015 Food sovereignty as decolonization: some contributions from Indigenous movements to food system and development politics. *Agriculture and Human Values*, 32(3), 431-444.

[30] Van Welzen, P C Parnell, J A N, & Slik, J W F 2011 Wallace's Line and plant distributions: Two or three phytogeographical areas and where to group Java? *Biological Journal of the Linnean Society*, 103(3), 531-545.
