Agricultural innovations and adaptation strategies among upland communities in the state boundaries of Kupang District (Indonesia) and Oecusse Enclave (East Timor)

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Abstract. Ngongo Y, Markus JER. 2020. Agricultural innovations and adaptation strategies among upland communities in the state boundaries of Kupang District (Indonesia) and Oecusse Enclave (East Timor). Trop Drylands 4: 51-57. Development started from the State's periphery has been implemented as a new paradigm or policy of national development in Indonesia. Agricultural Ministry translated this national policy by implementing several programs and one of them is promoting agricultural innovations to boost agricultural production and rural development in the State Boundary. This paper elaborates on agricultural innovations being introduced and adaptations of local people towards harsh climate and to protect natural resources. Data and information used mainly from the ongoing program of Agricultural Innovation Support (AIS) in the State Boundary of Kupang District of Republic of Indonesia and Oecusse enclave of Republic Democratic of Timor Leste (East Timor). Some insights of similar programs implemented in the three other districts of Timor that have land borderlines with East Timor have also used to enrich the narratives. Traditional honey beekeeping of Amfoang community used to demonstrate how local people maintain one of the important sources of their livelihoods and at the same time protecting natural resources. The study shows that agricultural innovation being introduced has successfully adopted by co-operators, however, it has limited impacts on the surrounding farmers/villages due to farmers’ poor access to the external inputs, market, and agricultural extensions. The paper concludes that agricultural innovations being introduced should be considering farmers’ circumstances, particularly harsh climate of the region, and it should compatible with household calendar both in farming and off-farming particularly in honey harvesting. Recognizing and supporting customary low honey harvesting helps protect forest and biodiversity in Amfoang and Timor in general. Promoting agricultural development and improving infrastructure in the State Boundary should be developed in such a way to strengthen and promotes conservation and protecting biodiversity in fragile ecosystem of Timor.

Keywords: Agricultural innovations, adaptations, fragile ecosystem, State Boundary, periphery

INTRODUCTION

Timor Island and East Nusa Tenggara (ENT), Indonesia in general have specific biophysical characteristics that differ from the western part of Indonesia. The region dominated with up-lifted coral-reef, unfertile soils, low and erratic rainfall (Audley-Charles 1965, 1974) that considered a fragile ecosystem (Ormeling 1957). These specific characteristics of the region have been less taken into consideration in National development programs at least up to the 1980s.

Despite improvement in terms of food security and income generation of upland farmers, agricultural development programs and better access/transboundary markets have also contributed to the deterioration of some important or specific upland commodities in semi-arid region of East Nusa Tenggara. For example, Timor Apple dominated local market up to 1970s have infected with Marssonina at the end of 1970s and completely destroyed in the 1980s. So’e oranges well known as JKS or jeruk keprok So’e is recently deteriorated by pests and diseases (Ngongo 2010), and very recently blood disease of banana in Sumba Island (Mudita and Benu 2018).

East Nusa Tenggara of Indonesian province has borderline with Republic Democratic Timor Leste (RDTL, East Timor) around 268.8 km long, which includes around 15.2 km long borderlines between Amfoang region of Kupang District and Oekusi District-an enclave area of East Timor (BNPP 2015). Amfoang region is considered the most isolated area in Timor Island due to lack of basic infrastructure. However, in line with central government commitment to develop Indonesia from the periphery, Amfoang regions recently encounter some programs to unlock the physical isolation of the region.

The need to improve food production and welfare of the people in the State Boundary should be started by introducing appropriate agricultural innovations. Ministry Agriculture through East Nusa Tenggara-Assistance Institute for Agricultural Technology (ENT-AIAT) has been supported farmers in the State boundaries of West Timor (Republic of Indonesia) and Republic Democratic Timor Leste (RDTL) since 2013 through introducing/improving agricultural innovation in order to increase agricultural production and farmers’ income. It is implemented through Agricultural Innovation Field Laboratory (AIFL) and similar program ideas continued up
to recently with so-called Agricultural Innovation Support (AIS) in the State Boundaries of RI-RDTL (Ngongo et al. 2018). This paper overview agricultural innovations in remote areas of State Boundary of RI-RDTL, particularly of Kupang district, farmer’s responses and adaptability of local people in the harsh environment.

MATERIALS AND METHODS

The study conducted in the State Boundary of Kupang District (East Nusa Tenggara Province, Indonesia) and Oecusse (East Timor/RDTL). Three villages namely: Netemnanu, North Netemnanu and South Netemnanu of East Amfoang Sub-district, Kupang District, East Nusa Tenggara Province, Indonesia (Figure 1) were chosen purposively based on the closedness or in the borderline with Oecusse enclave of East Timor where the adaptive research for food crops (rice and maize) from the Agricultural Innovation Support (AIS) Program in the State Boundary of Kupang District conducted. Data and information used were part of the AIS Program. Baseline data and information gathered before the Program started at end of 2016. Data and information updated and enriched during Adaptive Research/Program conducted from 2017 up to recently. The research employed descriptive method for data interpretation.

Some insights of similar programs implemented in the three other districts (Belu, Malaka, and Timor Tengah Utara) of Timor that have land borderlines with East Timor have also used to enrich the narratives.

RESULTS AND DISCUSSION

Overview of agricultural innovations of the region

Almost all upland farmers in State Boundary of Amfoang in Kupang District are still kept practicing traditional existing farming practices. Shifting cultivation with slash and burn agriculture still practices by dominant upland farmers with less or no external inputs use. Slash and burn or shifting cultivation has been practice in Timor in general since the 13th century and at the same time, Chinese traders reached Timor with the main motive to acquire sandalwood (Wolters 1967). This means that agricultural practices in the remote areas of Timor remain unchanged up to recently.

Although upland farming practice remains unchanged, local people were able to incorporate some new crops brought by outsiders, particularly by Chinese and Indian traders who acquired sandalwood (Schafer 1963). Introducing new crops continued during the Dutch colony, particularly horticultural crops were mostly planted in the highland of Mutis and Amfoang regions to supply local markets in Timor (Ngongo 2011). Upland farming practices and protection of natural resources in the region as a dual economy in subsistence crop production and source of cash income (Chopin et al. 2017; Shepherd and Palmer 2015).

Figure 1. The study site in East Amfoang Sub-district (red box), Kupang District, East Nusa Tenggara Province, Indonesia
Introduction of new crops before and during Colonial era has positive impact on the improvement of food security of local communities (Ataupah 1992). However, the introduction of livestock particularly cattle brought improvement of income of local people and negatively impacted the environment (Boxer 1949; Ormeling 1957). Until recently, Bali cattle almost replaced water buffalo in Timor. The region of Amfoang and Mutis becomes traditional breeding areas for Bali cattle and becomes major problems for crops farming and environment (Figure 2). Free-ranging cattle in the region limiting farmers to extend their crops land area and forced farmers to invest more labor for fencing to protect crops. Free-ranging cattle in the protected forest that let to wild make it hard to do vaccination and to control transmitted diseases.

In the same-arid region of Timor, water is the main constraint in food and fodders. During the long dry season, cattle heavily dependent on rice straw in abandoned lowland rice areas after harvest. Rice paddy field becomes common grazing for cattle that are limited or have no chance to develop dry season crops. One of the main innovations needed for this is how to provide good fodders of good quality.

Leucaena is the main innovation introduced both to provide good quality of fodder and to improve soil quality. This innovation is actually started in Amarasi and then *mutatis mutandis* spreads across Timor island and other parts of East Nusa Tenggara Province, Indonesia in general (Piggin and Parera 1984). Nevertheless, innovations based on Leucaena are less adopted by the farmers in Amfoang region. Contras to the Amfoang region, farmers in the neighboring area of Timor Tengah Utara (TTU) district have adopted and integrated Leucaena into their farming system. Indeed, most of the TTU landscape recently covered with Leucaena (Figure 3) permits cattle fattening system works and improves soil quality that shortens fallow periods in shifting cultivation practice.

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**Figure 2.** Cattle free grazing in the highland and in the lowland of Amfoang region. A. Free grazing cattle in the highland protected area, B. Free grazing cattle at the abandoned rice field after harvest

**Figure 3.** Innovation based Leucaena in TTU. A. Landscape covered with Leucaena in TTU District, B. Leucaena in dominating rocky land cut for land preparation of upland farming in TTU District
Key informants in East Amfoang informed that the main reason why Leucaena and related fodders innovations do not work in Amfoang region is due to people feels that there is enough open access area, including in government-protected area that can be used for free grazing. They also feel that they have enough fertile soils in the coastal areas for crop farming and then become grazing areas during dry season.

Based on the above account, very limited agricultural innovation is being introduced and adopted by farmers in the Amfoang region. Adoption constraints are more on socio-cultural aspects rather than technical aspects. Therefore, institutional and social engineering should go parallel with the technical aspect of bringing improvement in Amfoang.

Overview induced agricultural innovation in the State Boundary

Of the four districts in West Timor that have land borderline with East Timor, Kupang District is the last district where agricultural programs for State Boundary implemented. Belu District is the district that gets first benefit of the program. Related programs to improve food crops productivity started in Belu in 2013, while in Kupang District started in 2017.

Under the AARD&D-Ministry of Agriculture has launched the Field Laboratory of Agricultural Innovation (FLAI) program in 2013/2014. The FLAI program implemented first in Belu District as part of the AARD&D’s commitment to developing State Boundary through accelerating agricultural innovation adoption rate. The main goal of FLAI is that to increase the roles of agricultural sector in order to improve people’s welfare in State Boundary through agricultural innovation.

The FLAI program was designed to improve productivity of six main commodities, i.e.: rice, maize, mungbean, horticulture, cattle, and forage. All activities have been carried out in the concept of CLS and zero waste. All activities focused on Raihat Sub-district of Belu District. Adaptive research for those commodities was carried out in the flatland along Malibaka river bank. Innovation being implemented to improve farming practices has significant impact to increase productivity for all commodities. Innovation related to lowland rice farming has profound impact to improve rice production and it has triggered increasing rice planting area and increasing adoption rate of rice innovations.

Besides continuing improving agricultural innovations in specific farming circumstances of Indonesia-East Timor, FLAI program in 2016 was focused on improved food crops (rice, maize, and mungbean) production and to keep improved farmers group seed institution. By the program, farmers group rice seed producer in Raihat was also able to produce seed that supplied to the neighboring districts of Malaka and TTU and even to neighboring farmers in Maliana District of RDTL (BPPT-NTT 2016).

Agricultural innovation was introduced in State Boundary of Kupang District based on the baseline survey conducted at the end of 2017. It was revealed from the baseline survey that productivity for all commodities considered low and almost no external input or new innovations implemented in the existing farming systems. In these circumstances, AIAT, in collaboration with farmers and extensionists, agreed to conducted adaptive research for staple crops, first: rice and maize, and then will introduce other innovations related to livestock and income generations.

Adaptive research for maize was conducted in South Netemnanu, while rice was conducted in North Netemnanau village of East Amfoang Sub-district in 2017/2018 rainy season. First-year implementation of the program was a challenge due to limitations in human resources (farmers) and extension workers who have passion for staying in the field due to poor infrastructure. Nevertheless, those farmers who were involved in adaptive research (co-operator farmers) showed excellent performance. Implementation of recommended innovations has significant impact on the improvement of productivity and production of both commodities. Productivity of three HYVs introduced namely Inpapi, Inpapi 6, and Ciherrang increased doubled (6.6-7.23 ton/ha) compared with local variety (3.26 ton/ha). The productivity of HYVs has steady consistent in the last three planting seasons. Similar to rice, there was steady increase of introduced maize (Lamuru) productivity of 4-5 ton/ha compared with the existing local variety of maize (0.8-1.2 ton/ha) (BPPT-NTT 2018).

The above account revealed that farmers in semi-arid areas, at least Co-operator farmers in the State Boundary, are willing to adopt new innovation if it suits their household circumstances. Marginal farmers in semi-arid areas tend to be vigilant and try to minimize risk for any introduced innovation.

Food security and protection of natural resources:

Honeeybee case

Food security is still the main priority for household and small farmers in general in State Boundary; however, Timorese dominated Meto tribe in State Boundary of Kupang Districts always feels secure in food production. Secure or enough for local people does not mean that food production is enough for households. Rather, they try to manage food production and combine them with access to forest products to meet household’ food security.

There are several ways for people in State Boundary to ensure household’ food security. The most common strategy is by planting many possible food crops in a parcel of land or in several parcels of land at farm level. McCord et al. (2015) stated that: “Crop diversification is one strategy that smallholder farmers may employ to reduce their vulnerability in the face of global environmental change.” Farming in the semi-arid areas visage high risk of failure mainly due to water limitation. Therefore, planting many possible crops ensures that at least one or two crops or species will be harvested and can minimize vulnerability.

The upland farming practice fully depends on rainfall and therefore it could be practiced during rainy season (November/December-March). Like other places in Upland
Timor, main food crops in upland are maize, pumpkin, and beans, however, the composition of the crops is varies based on the zone agro-ecosystem and farmers’ experiences on their land. Upland farmers in hillsides of Mutis, for example, plant more roots crops like sweet potatoes and vegetables. No maize planted in the highland during rainy season due to cool weather and strong wind during monsoon season. Limited area of maize planted in the highland only during the dry season.

To meet their staple food (maize) needs, people in the highland do have a parcel of land in lower attitude that suits maize. They keep planting root crops and vegetables in the highland both in rainy and dry seasons mainly for cash income (Figure 4). Every household has difference sizes of land, species of plants, and business scale.

For Timorese in the State Boundary of Amfoang-Kupang district, natural resources, particularly forests, are important parts of food security. Food deficit from upland farmers can be compensated from the non-timber forest products like Dioscorea sp., and most importantly honey. Protecting forest for the local people have positive correlation or direct impact on maintaining the traditional honeybee management. Dominant respondent farmers in the State Boundary of Kupang district revealed that main source of cash income become first priority in managing honeybees. Other important motives are conserving norms and local traditions, protecting biodiversity, and ecology functions (Table 1).

Tobe (or Elders) who responsible for the management of honey will be making an announcement to the community and set calendar from “calling the honeybee,” harvesting up to let “the honeybee return to its first kingdom place.” A ritual to call the honeybee to come in the community’s forest concession performed in the arranged stone altar.

According to the respondents in Netemnanau village, best honey quality occurred during Eucalyptus sp flowering, and therefore people are strictly prohibited to cut-off even single branch of Eucalyptus during this trees flowering. People are also strictly prohibited to cut some trees where honeybees normally hanging. Those who are violating traditional rule will be punished by paying animals (normally pig) and rice. Blood from the slaughtering of animals is considered atonement with the “wounded nature” or to calm down the “angry nature” and then reconcile with nature.

Besides protecting Eucalyptus Sp. as main source of nectar, Elders in Netemnanu village informed that they also strictly protect the trees where the honeycomb normally hanging. They noticed five important trees such as Fanik, Neke, Nisa/Nitas, Niku, and Bonak. Tobe Oematan figured out one of the Fanik trees (Figure 5) that he predicted it ages around 250-300 years old based on his grandfather's story.

Besides protecting the forest, local people also protect the honeybee by letting the honeybee reproduce twice before its honey harvest. This strict role is still implemented until recently. They started to harvest the honey when Tobe oversaw that honey mature enough to be harvested. He stated that they normally harvest first of the honey mature in the lowland and then followed with the midland and the last harvested in the highland.

### Table 1. Respondents motives in traditional honeybee management (n=45).

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<thead>
<tr>
<th>Aspect/s</th>
<th>%</th>
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<tbody>
<tr>
<td>Main source of cash income</td>
<td>93</td>
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<tr>
<td>Ecology functions</td>
<td>53</td>
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<tr>
<td>Protecting biodiversity</td>
<td>79</td>
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<tr>
<td>Conserving norms and tradition of honeybee keeping</td>
<td>89</td>
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</tbody>
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Figure 4. Various crops planted in the highland. A. Limited maize and various vegetables farmers during the dry season in the Highland. B. Various crops in a parcel of land during dry season in Highland.
Honey is harvested together by a group of people that have a traditional concession forest area. Those involved in honey harvest should follow traditional procedures and, most importantly, have "clean heart." They make a camp in the forest and stay there to complete the harvest for around two weeks. They do harvest during the night time (07.00 pm-04.00 am) while rest and preparing logistics during the day. Harvested honey will be shared equally with all members of the group.

Tobe Oematan in Netemnanau village informed that they do harvest honey twice a year: April-May and September-October. The best quality of honey harvested...
during first harvest season (April/May) where Eucalyptus flowering; while second harvest occurred during the dry season where limited trees get flowering. For Tobe Oematian, selling honey is main source of cash income and it helps to compensate of food shortage or crop harvest failure. Crops harvest failure may occur, but no total harvest failure of honey in his forest concession.

Collecting honey in Amfoang and Timor, in general, is considered one of the ancient activities of the local people. Collecting honey has broad impacts not only on the household income but also on the community's environment and social relations (Lyon and Parkins 2013). It is predicted that around 40% of the household involved directly in honey harvesting. According to the Elders in Tuamnanu village, they have strict roles in managing the traditional honeybee harvesting business. They proud that they have to keep their traditions particularly for hanging honeybees; however, they are quite permissive for cave/underground honeybees.

The position of Tobe is inherited from his descendants and it cannot be transferred to other members of community. Every Tobe has its community concession land for generation that can encompass at least one village. The altar where the Tobe and community members perform ritual for honey bee management in Netemnanu village is part of government Forest Area; however, local people can freely take the benefit of the forest and at the same time protect the forest.

In conclusion, traditional upland farming system keeps practiced in the State Boundary of RI-RDTL RIRDTL as a direct implication of less agricultural innovations offered in the region. The remoteness or isolation of the region has limited farmers to access agricultural innovations and the market. Nevertheless, recent New Paradigm in looking State Boundary by central government as “Front Porch” has promoted improvement in many aspects of rural development in the region. Lesson from the AIS program in State Boundary showed that there has been increase in maize and rice productivity for co-operators and surrounding farmers who implement recommended innovation. Farmers are willing to adopt any agricultural innovations that suit household resources and their environments. Farmers were able to harmonize farming activities and protecting natural resources, particularly in relation to honeybee management. Dry-forest dominated with Eucalyptus in Amfoang-Mutis has played important roles in semi-arid ecosystems. It is important to ensure that any government programs to open the isolation of the region by improving infrastructure in the State Boundary will maintain balance between the will to increase agricultural production and protection of natural resources.

ACKNOWLEDGEMENTS

The authors would like to thank AIAT-ENT technicians assistance and extension workers for helping research Tim in data collections. We also thank Tobe (Elders) and farmers groups for providing valuable data and information related to farming practices and protection of natural resources. Thanks also go to anonymous reviewers for valuable comments for improvements of the paper. We respect and thank Noldy R.E. Kotta for editing and managing references. Any remaining errors are authors’ responsibility and they have equal contribution in writing and publishing this paper.

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