



AI-Com Natural Resource Management Survey

Natarbora Administrative Post, Manatuto Municipality, Timor-Leste

In Partnership with MAF and UNTL

Prepared by AI-Com Socio-Economic Research Team





**AI-Com Natural Resource
Management Survey
Natarbora Administrative Post,
Manatuto Municipality, Timor-Leste**

In Partnership with MAF and UNTL



Prepared by AI-Com Socio-Economic Research Team

AI-Com is a collaborative research program between the Ministry of Agriculture and Fisheries (MAF), the National University of Timor Lorosa'e (UNTL), World Vision Timor-Leste and the University of Western Australia (UWA).

AI-Com is supported by 'Australian Centre for International Agricultural Research' (ACIAR) from 2016 to 2021 .

AI-Com aims to improve agricultural productivity and profitability in pilot communities by:

1 Addressing technical and social impediments to annual crop intensification, and

2 Establishing fodder tree legumes (FTL) and sandalwood as a sustainable income source and land management practice.



Executive Summary

The AI-Com natural resource management survey (NRM) was carried out between 19 and 30 August 2018. The NRM survey covered the three villages of Uma Bocu, Sicone Diloli and Aubeon in Natarbora Administrative Post, Manatuto Municipality. These three villages were chosen based on AI-Com's target area selection criteria, namely:

1 Villages need to belong to inland irrigated areas with

paddy rice, or on the south coast with a shallow water-table, communities must have an interest in...

2 Intensifying crop production

3 Growing sandalwood

4 Growing leguminous trees

5 Variations in landscape

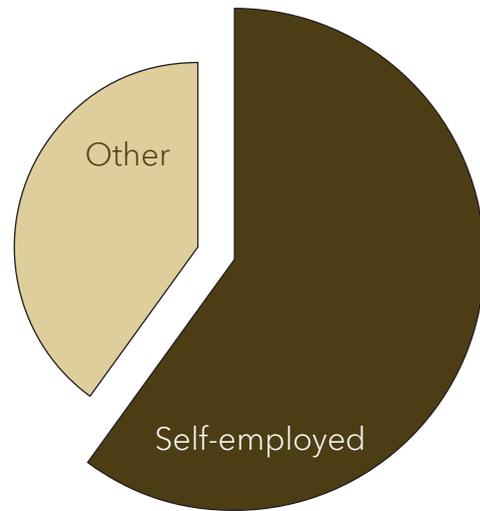
within the villages

6 Variation in hamlets in land ownership, and have

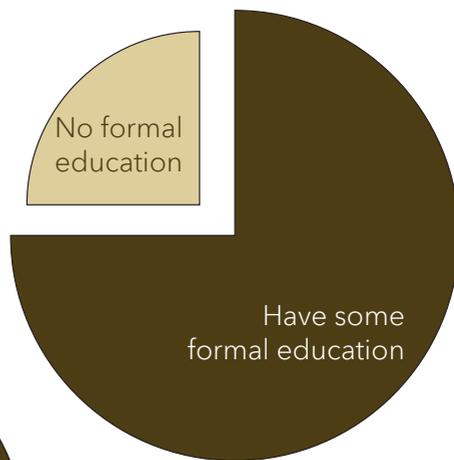
7 Rice cultivation areas. Based on these criteria, the NRM survey's main objectives were to establish a socio-economic baseline profile of each of AI-Com's target communities and to understand community land use practices and natural resources management. The NRM survey used a mixed-methods approach comprised of a household questionnaire (169 respondents), focus group

discussions (40 participants) and field observations. Respondents were asked to report their farming practices in the last cropping season prior to the commencement of the NRM survey in August 2018. A summary of the main findings is provided in the following pages.

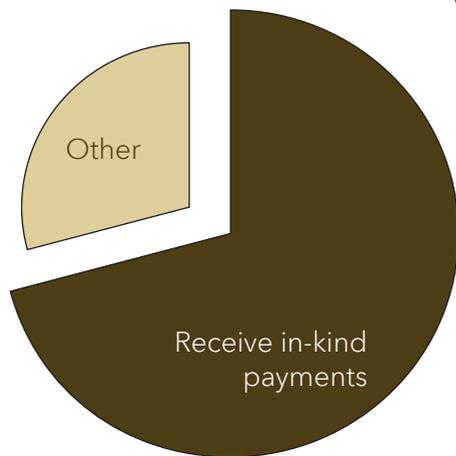
Household Socio-Economic Profile



Most survey respondents in Natarbora are of Tetun-Terik ethno-linguistic group (97%). They are mainly self-employed smallholder farmers (66%) engaged in raising livestock and crop cultivation.

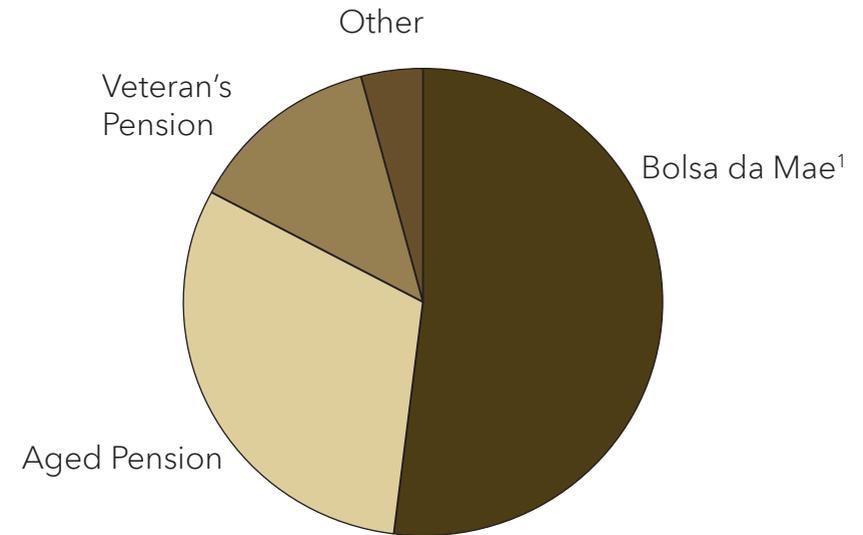


Seventy-five percent of surveyed heads of households had received formal education.



In terms of remuneration, 71% of respondents received in-kind payments.

Government Social Transfers that Households Receive



Despite over half of the surveyed households reporting family members who resided in another municipality, Dili, or overseas, only 16% of these households received remittances either in the form of money or gifts.

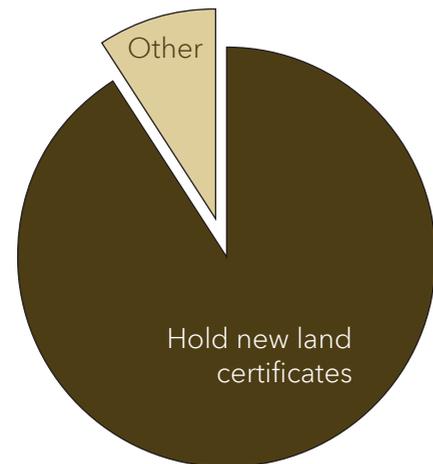
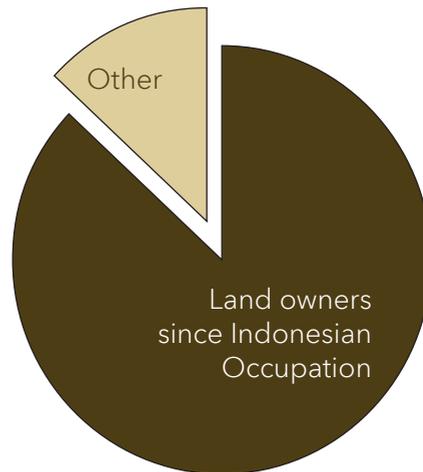


Knowledge of micro-credit and loans services was low amongst respondents (41%). Banks were reported to be the main source of micro-credit and loans (38%).

¹A government cash transfer scheme for children living with single-parents or in low-income households

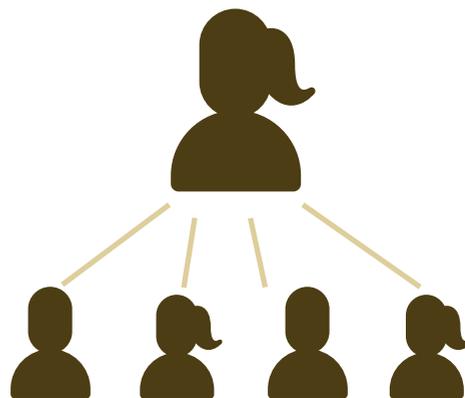
Land Ownership and Land Use Practices

Eighty-seven percent of respondents stated that they were the owners of the land they lived on and most obtained their residential land from the Indonesian administration during the occupation years due to forced resettlement.



Ninety-one percent of total respondents held land certificates, with the majority acquiring new land certificates and less than 10% holding Indonesian and Portuguese era certificates.

Social membership is typically transmitted matrilineally among the Tetun-Terik ethno-linguistic group, and family land and resources may be inherited by both sons and daughters.



Above: Conservation agriculture practice in Sicone Diloli.

X2



On average, survey respondents owned two plots of cultivation land and cultivated two plots of land in the last cropping season in 2018. The average number of plots cultivated in a season, regardless of ownership, is also indicative of labour and other inputs available to farmers.

This region is characterised by what respondents referred to as "moist land" (rai matak), which is fertile and can be cultivated throughout the year.

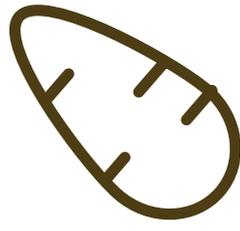
Top 3 Crops (2018)

Most respondents planted crops in the last cropping season in 2018 (82%).



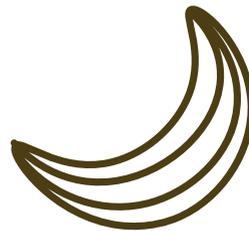
31%

Maize



27%

Cassava



15%

Banana

Of these major crops, the maximum yield of maize was...

4 tons/ha

In Aubeon Village

1.1 tons/ha

In Uma Bocu Village

0.8 tons/ha

In Sicone Diloli Village

1.4 tons/ha

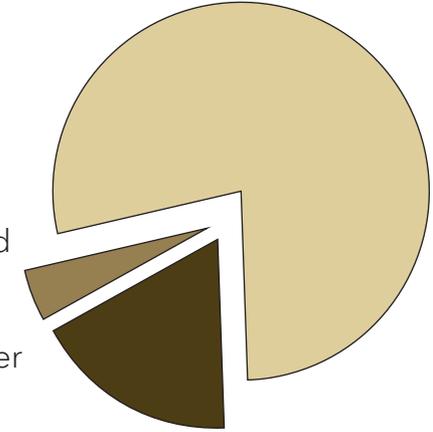
The top three crops sold reflected the top three crops planted by respondents: maize (33%), cassava (17%), and banana (11%).

Rice can be cultivated up to twice or thrice a year and likewise, maize can be cultivated twice or thrice a year in Natarbora. Nonetheless, most respondents only grew rice and maize once a year due to constraints posed by labour and other inputs.

¹Cassava and banana production were difficult to measure because farmers did not systematically calculate how much they harvested.

Agricultural labour is usually performed by household members without remuneration.

Only 22% of respondents paid agricultural labourers; 80% paid labourers daily wages (between \$3USD to \$5USD per day) and 20% paid in-kind.



Costs incurred by farmers:

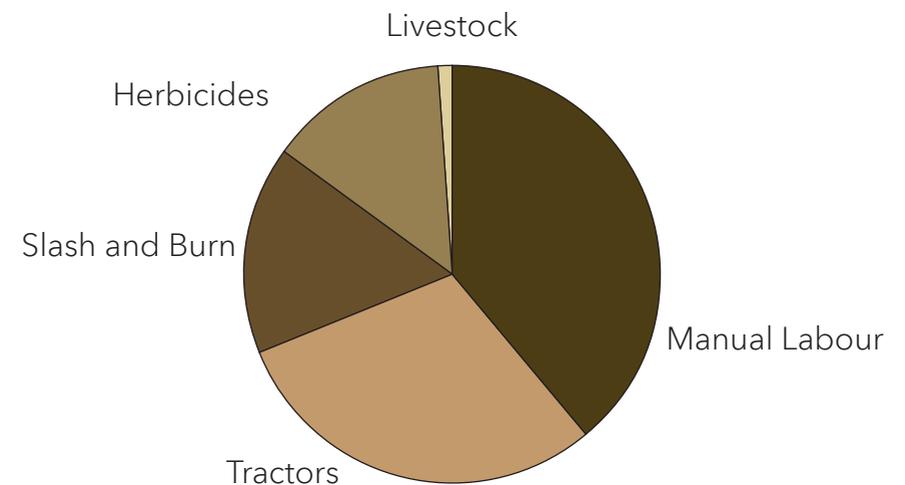


\$40USD-\$70USD/ha for tractor hire, plus fuel, \$1USD-\$2USD/litre



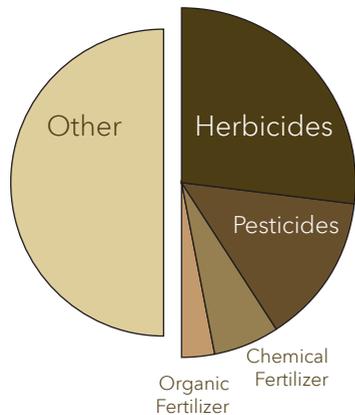
\$3-5USD in daily wages to labourers

Land Preparation Techniques



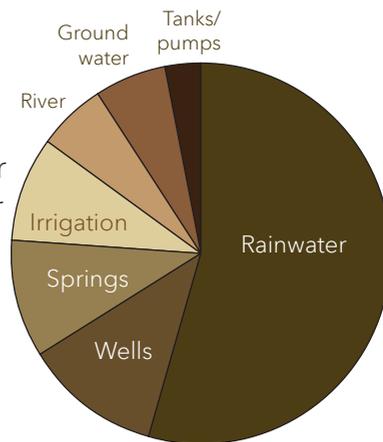
Land Inputs

Fifty percent of respondents who cultivated in the previous season did not apply any inputs to increase production or reduce labour and time in the field.



Herbicide was the most popular input used (27%) followed by pesticides (14%). Very few farmers applied chemical fertilizer (6%) and organic fertilizers (3%).

The most common source of water for farming is rain fed (55%). Other water sources include wells (12%), springs (10%), irrigation (9%), river (6%) and ground/bore water (6%). Three percent of respondents used water from tanks or electric pumps (sanyo).



Although most respondents depend on rain-fed farming, use minimal inputs, manual labour and tractors to cultivate their land, there has been changes in land preparation techniques, inputs used, labour remuneration and crop varieties in both dryland and wet rice cultivation in Natarbora from the Portuguese times until present.

Right: AI-Com trials with Farmers in Aubeon on growing mung bean after rice.



NRM and Tara Bandu Practices

Tara bandu is a customary form of natural resource management (NRM) widely practised in Timor-Leste. In Natarbora, all three villages have customary authorities (mostly men) who governed natural resource access and conservation efforts. Through ritual prohibitions, *tara bandu* promotes the regeneration of resources. *Mak Lehat* is an environmental steward who governs terrestrial resources, such as trees, forest products, and wild animals. *Mak Sabar* is similarly an environmental steward that regulates marine resources, including sacred springs, lakes, mangroves and marine animals, and they conduct rituals near the sea. These stewardships are passed through one's lineage or origin 'house' (*uma lisan*). Although *tara bandu* was locally enforced in the three villages at the time of the survey, many respondents stated that it was not fully effective due to competing demands on resource use and conservation. Livestock and

Through ritual prohibitions, tara bandu promotes the regeneration of resources.

hunting wild animals are important sources of food security, livelihood and income. Hunting was considered a supplementary livelihood activity, which provided food and generated fast and easy income.

Right: Tara bandu post marking agricultural and social prohibitions in Suco Sicone Diloli and Aubeon.



Participation in Agricultural Innovations Programs

Discontinued innovation adoption or application may indicate either ineffective communication of innovations to farmers or costly access to innovations.

Respondents had participated in programs which introduced agricultural innovations. The most common program was using new agricultural techniques (26%), natural resource management (22%), planting new varieties (17%), commercial seed production (15%), conservation agriculture (14%) and irrigation program (6%). There was varying levels of innovation adoption once the programs ended. Discontinued innovation adoption or application may indicate either ineffective communication of innovations to farmers or costly access to innovations.

Interest in Sandalwood

Most respondents (82%) expressed an interest to trial sandalwood. In particular, respondents recognised the high market value of sandalwood and its significance as an inter-generational source of income. Respondents who were not interested in sandalwood stated that they were either confused or undecided about planting sandalwood, did not have land to plant sandalwood, or were skeptical that sandalwood could thrive on the lowlands. Appropriate farmer education and training on sandalwood and agroforestry that takes into account of existing social, economic and environmental conditions is recommended to ensure long term adoption and sustainable outcomes.

...respondents recognised the high market value of sandalwood and its significance as an inter-generational source of income.

Introduction

As part of AI-Com's first objective which is "to understand community decision-making for natural resource management and to pilot a cycle of land use practice change", AI-Com socio-economic (SOSEK) researchers conducted a baseline survey on land use practices and natural resource management (NRM) in three villages in Natarbora Administrative Post, Manatuto Municipality, Timor-Leste. Manatuto is located to the east of Dili but the municipality stretches from the north to south coast of Timor-Leste. Manatuto is one of the country's least populated areas and characterised by a rugged mountainous interior and sparsely vegetated terrain. Large rivers drain to the north and south coasts, flowing for most of the year and less so during the dry season. Manatuto has six Administrative Posts and 29 villages. Since AI-Com is interested to work in the south coast area, three target villages in Natarbora Administrative Post were selected: Uma Bocu, Sicone Diloli and Aubeon. Geographically, these three villages are located on the lowlands, adjacent to one another, and share similar cultural



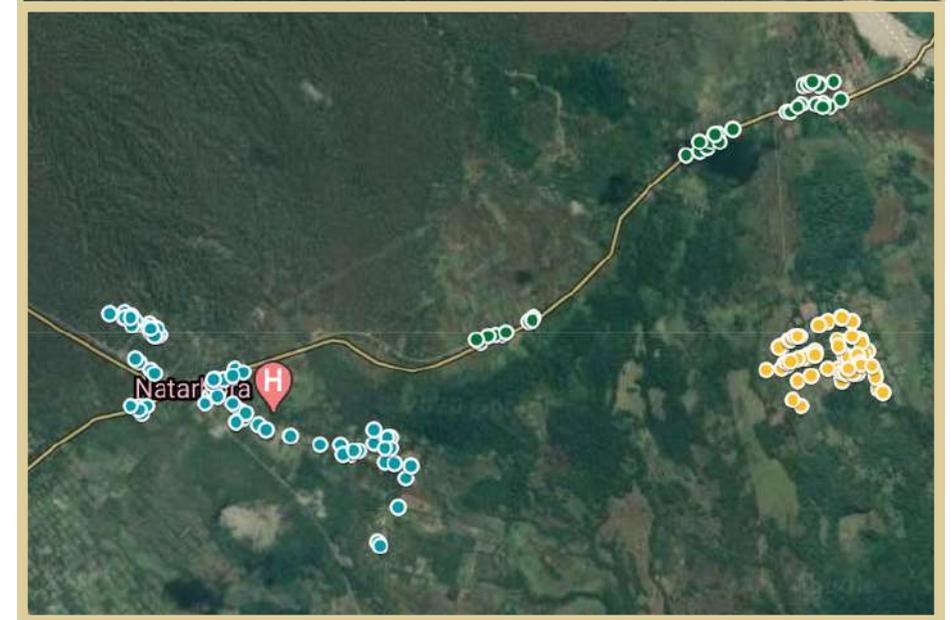
traits. However, each village has a distinct but intertwined history of forced resettlement during the Indonesian occupation of Timor-Leste (1975-1999), giving rise to varying degrees of land ownership and access rights within the communities.

Uma Bocu village is the centre of Natarbora. The village comprises of two hamlets, Fehuk Rin and Halibur. Uma Bocu is situated on cultivation land which was historically used by an upland community known as Fehuk Rin. During the early years of the Indonesian occupation, upland communities in Natarbora (known as Barique previously), including the customary landowners in Fehuk Rin, were forcibly resettled onto the lowland areas. Populations from other places, such as Viqueque, to as far as Maubise and Aileu

were also concentrated in this area. This new lowland resettlement site was renamed Uma Bocu. The Indonesian administration provided cattle and two parcels of land for all resettled households (parcel 1: 25m x100m and parcel 2: 75m x100m). The Indonesian administration further built an agriculture technical high school in 1981 and a hospital in Uma Bocu. The high school was rehabilitated after national independence. The hospital was burned down during the outbreak of war in 1999, which marked the end of Indonesian rule, and rehabilitated in 2000. At present, Uma Bocu continues to be inhabited by customary landowners and migrants from other villages and municipalities.

Left: Map of Manatuto Municipality.

Source: J. Patrick Fischer, Wikimedia Commons.



Legend for survey respondent locations:

-  Uma Bocu survey respondents
-  Sicone Diloli survey respondents
-  Aubeon survey respondents

Sicone Diloli is a new administrative village established on 31 March 2017. Before this period, Sicone Diloli was a hamlet (named We Onu) within Uma Bocu village. Since March 2017, this new village was established with two hamlets, We Onu and We Kandia. Uma Bocu village's boundaries were redefined, comprising of Fehuk Rin and Halibur hamlets. Most community members in Sicone Diloli village are customary landowners. In 1998, a local transmigration program (*translok*) was established to relocate Sicone Diloli's population to their origin place (i.e. their present location), in an area called Ai Meta Laran. Each household was allocated 50m x100m of land. However, Sicone Diloli remained within the village boundaries of Uma Bocu until 2017.

Finally, Aubeon village was a transmigration area established by the Indonesian government in 1994. A total area of 600 hectares (ha) came under the transmigration

scheme, and the new village comprised of two hamlets, Bubur Laran and We Kadi. An estimated 225 Timorese households from the upland origin village (also named Aubeon) in mountainous Barique and some other places, 75 Balinese households and 25 Javanese households were resettled on the lowlands. Prior to the resettlement program, the lowland area was sparsely occupied by populations from the original Aubeon village in the hills. Each household was supposed to receive 2 ha of land for residential (25m x 100m) and cultivation (75m x 100m). However, this process was left incomplete due to warfare in 1999.

Since national independence, all three villages have been beneficiaries of development programs, including those related to agriculture; livestock and environmental conservation.

In 1998, a local transmigration program (translok) was established to relocate Sicone Diloli's population to their origin place... in an area called Ai Meta Laran.

Each household was allocated 50m x100m of land.

The respondents in AI-Com's household survey were mainly of Tetun-Terik ethno-linguistic group (97%). Seventy-five percent of respondents have had formal education. Of these, 33% of respondents had primary school level education, 28% with secondary school or higher level education, and 24% who attended up to pre-secondary school. Fifteen percent of respondents were educated during the Portuguese colonial period (equivalent to primary school education). Only 25% were illiterate.

Objectives

The objectives of this survey are as follows:

- 1** Collect baseline information on the socio-economic conditions of each target community in Natarbora.
- 2** Understand land use practices and natural resource management (NRM) in the target communities.

Methodology

Target Communities

This NRM survey was conducted from 19 to 30 August 2018 in Natarbora. Before undertaking the NRM survey, a preliminary survey was conducted to identify target communities on the lowlands of Natarbora based on AI-Com's selection criteria (see Table 1). The background information obtained from the pilot fieldwork in Natarbora was matched with the 2015 Timor-Leste national census, as described in Table 1. Based on the selection criteria, three villages on the flat plains of Natarbora were identified; the villages were Uma Bocu, Sicone Diloli and Aubeon. Abat-Oan (Fatuwake) village was not selected because this village does not have rice fields, which is one of AI-Com's main criterions to implement its research program.

Table 1: The selection criteria for each village on the lowlands of Natarbora Administrative Post, Manatuto Municipality.

Table 1 continues on next page.

Selection Criteria	The four villages in Natarbora Administrative Post, Manatuto Municipality			
	Abat Oan (Fatuwake)	Aubeon	Uma Bocu	Sicone Diloli
Villages need to belong to inland irrigated areas with paddy rice, or on the south coast with a shallow water-table.	Inland	South coast with a shallow water-table	South coast with a shallow water-table	South coast with a shallow watertable
Community must have an interest in intensifying crop production	Yes	Yes	Yes	Yes
Interest in growing sandalwood	Yes, if it is valuable	Not sure yet	Not sure yet	Yes
Interest in growing leguminous trees	Yes	Not sure yet	Yes	Yes
Variation in landscape within the villages	Only flat area	Only flat area	Both flat and hills	Both flat and hills
Contain Seeds of Life Program seed producer groups that are active or not	Yes	Yes	No	Yes
All-season road access	Yes	Yes	Yes	Yes
Variation over hamlets in land ownership: settlers v. customary land ownership.	The village is a trans-migrated area (people moved from Laclubar, Uma Bocu, Soibada, Manehat)	The village is a trans-migrated area (people moved from Manehat, Laclubar and Soibada)**	Customary landowner and some migrate from other villages	Customary landowner

Rice cultivation area	No	Yes	Yes	It has more than 50 hectares rice field
Flat areas	Yes	Yes	Yes	Yes
Sandalwood grown	Few households started to grow it	Few households started to grow it	Few households started to grow it	No
Close to agriculture high school	About 20 minutes' drive	About 35 minutes' drive	About 5 minutes' drive	About 25 minutes' drive
Has active extension agriculture officer	Yes	No	Yes	Yes



End of Table 1.

Research Methods and Sampling

This survey drew on quantitative and qualitative research methods, comprised of a household (HH) questionnaire, focus group discussions (FGD) and field observations.

The household survey was undertaken by randomly selecting 20% of the total households in each of the three villages. The interviews for the survey were conducted with either the male or female head of households. Total participants for the HH questionnaire was 169, consisting of 90 female and 79 male respondents. Total respondents from each hamlet in each target village (based on gender) are listed in Table 2.

Right: Meeting with village head in Suco Uma Bocu.

Village/Hamlet	Male	Female	Total
Aubeon	27	34	61
Burbur Laran	19	15	34
We Kadi	8	19	27
Sicone Diloli	24	9	33
We Kanria	15	2	17
We Onu	9	7	16
Uma Bocu	39	36	75
Fehuk Rin	31	27	58
Halibur	8	9	17
Total	90	79	169

Table 2: Total respondents from the 3 villages who participated in the HH survey.

Focus group discussions (FGD) were conducted at the village level over a period of three days, with each FGD lasting between three to four hours. Participants of different age groups, sex and socio-economic status (e.g., farmers, elderly and youths) were selected to gain diverse perspectives within each community. Local leaders also participated, including the heads of villages and hamlets, ritual elders, and members of the village committees for NRM (*tara bandu*).

As shown in Table 3 below, there were more participants for FGD in Sicone Diloli than in Aubeon and Uma Bocu. The higher number of participants in Sicone Diloli was due to strong interest by villagers to participate.

Village Name	Number of Males	Number of Females	Participants
Aubeon	6	5	11
Uma Bocu	8	4	12
Sicone Diloli	12	5	17
Total	26	14	40

Table 3: Total participants from the 3 villages who participated in the FGD activity.

Finally, the research team undertook field observations to survey:

- 1** The major natural resources which are found in each village,
- 2** Local storage systems of staple crops and
- 3** NRM or *tara bandu* (ritual prohibition of natural resource use) sites.

The household questionnaire was designed using an open-access e-survey tool, Open Data Kit (ODK) and administered electronically using Android tablets. The analysis was undertaken using MS Excel and SPSS software. Qualitative data, which were recorded as hand-written notes, were transcribed and translated from Tetum to English before they were organised to draw out the main research themes.

Below: Men and women FGD in Uma Bocu.



Socio-economic Profile of Households in Natarbora

Survey respondents were asked to share their farming practices for the last cropping season prior to the period in which the NRM survey was conducted in August 2018. The results presented in this report therefore reflect land use practices and natural resource management for this period.

Household Land Ownership and Access

Land ownership and access rights influences land use practices. Eighty-seven percent of respondents stated that they owned the land they lived on and 13% of respondents did not own the land on which they resided. Closer examination of land ownership across the three villages showed that a higher percentage of respondents (both men and women) in Uma Bocu did not own their residential land. This might be indicative of historical population migration within the village and the lack of land ownership amongst settler-migrants. Comparatively, Aubeon and Sicone Diloli were mainly occupied by customary landowners. The data sorted by village and gender is summarised in Table 4.

Do you own the land you live on?	Aubeon (%)		Sicone Diloli (%)		Uma Bocu (%)		Total (%)
	Female	Male	Female	Male	Female	Male	
Yes	96	100	92	100	72	78	87
No	4	0	8	0	28	22	13

Table 4: Land ownership and access sorted by villages and gender.

Apart from the 13% of respondents who did not own the land they resided on, most female respondents (20%) who reported to be landowners stated that they obtained the land from their father, followed by the Indonesian government (17%) and Timor-Leste government (17%). By contrast, most male respondents reported to obtain the land from Indonesian government (29%), followed by the respondent's father (20%), Timor-Leste government (13%) and some other sources as listed in Table 5 below.

If yes, how did you get the land you live on?	Female (%)	Male (%)	Total (%)
From Indonesian Government	17	29	22
From father	20	20	20
New registration/TL Government	17	13	15
From father in-law	10	8	9
From mother	9	8	8
From family	2	4	3
From mother in-law	3	3	3
From landowner	1	3	2
From head of village	2	1	2
Purchase	2	0	1
From cultural leader	1	0	1
From Portuguese Government	0	1	1
n/a¹	16	10	13

¹Non Identified refers to the 13% of respondents who do not own the land they live on.

Table 5: Sources of land respondents obtained, sorted by gender.

When land ownership is considered from a gender perspective, female heads of HH also have rights to obtain land from their parents because the south coast area of Natarbora are dominated by the Tetun-Terik ethno-linguistic group. Through FGDs, participants further explained that Tetun-Terik culture places equal emphasis on sons and daughters in terms of family resource transfers. However, there is a slight preference towards matrilineality. The first-born child always enters into his/her mother's origin group or origin 'house' (*uma lisan*) and the subsequent children are divided between the mother's and father's origin groups. This cultural practice might explain why some female heads of HH obtained land from their fathers as compared to patrilineal ethno-linguistic groups such as the Mambae, Makasa'e, and Kemak where sons predominately inherit family land and other resources.

The first-born child always enters into his/her mother's origin group or origin 'house' (uma lisan) and the subsequent children are divided between the mother's and father's origin groups.

The total number of respondents who obtained land from the Indonesian government (22%) can be explained by the fact that many households in Natarbora experienced state-enforced resettlement during the Indonesian occupation as discussed earlier in the Introduction.

Out of this total, the highest percentage was in Aubeon (17%), which was an Indonesian era transmigration village. In fact, these respondents in Aubeon were resettled from different places of origin, and mostly from Natarbora/Barique, Uma Bocu, Laclubar, Soibada, and others from Cribas, Manehat (an upland village in Natarbora), Viqueque, Baucau, Maliana and Same.

The Timor-Leste state is currently registering land and property, including in the rural areas. Respondents were therefore asked if they held land certificates. Most of the respondents who were landowners, regardless of male or female HH heads stated that they held new land certificates (91%) and only 9% did not, as shown in Table 6.

Do you have a land and property registration or certificate?	Aubeon (%)		Sicone Diloli (%)		Uma Bocu (%)		Total (%)
	Female	Male	Female	Male	Female	Male	
Yes	100	94	96	100	85	83	91
No	0	6	4	0	15	17	9

Table 6: Land and property registration or certificate, sorted by village and gender.

Furthermore, out of the 91% of respondents who held land certificates, 94% obtained their certificate from the Timor-Leste government and only 6% obtained their land certificate previously from the Indonesian government (5%) and Portuguese government (1%).

Out of the 13% of total respondents who were not landowners, both male and female HH heads stated that the land they lived on was owned by their family or relatives (7%), the Timor-Leste government (4%) or community land (2%).

Household Cultivation Land

Household Land Ownership and Access

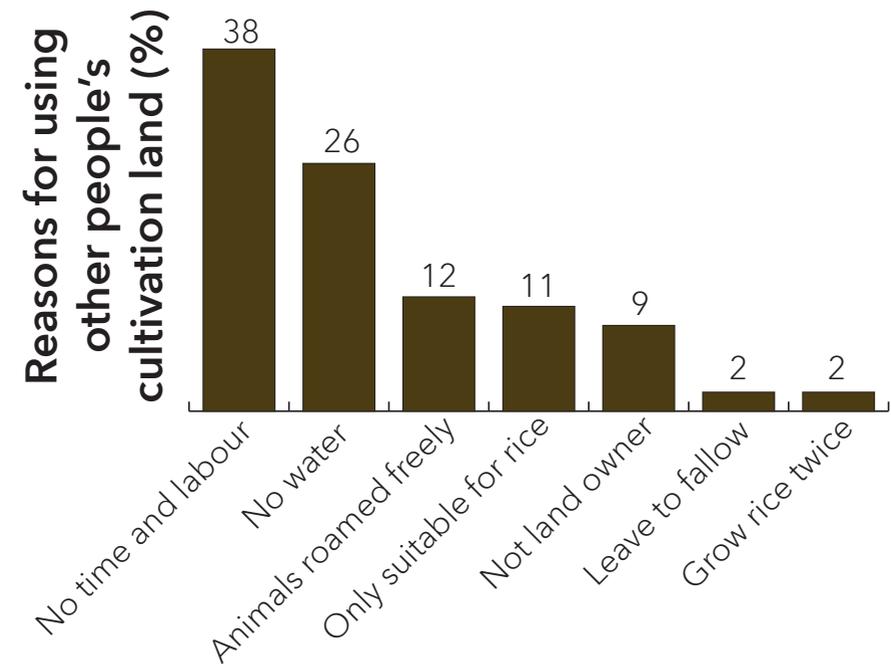
Ninety three percent of total respondents interviewed either owned or had access to cultivation land and only 7% did not have cultivation land, as listed in Table 7 below.

Cultivation land ownership in villages	Have cultivation land (%)	Do not have cultivation land (%)
Aubeon	93	7
Sicone Diloli	100	0
Uma Bocu	89	11
Total	93	7

Table 7: Ownership and access to cultivation land, sorted by village.



Among those who owned or could access cultivation land, 20% of respondents used other people's cultivation land. The reasons cited for using other people's land were because respondents did not have cultivation land (41%); other people's cultivation land was close to their residence (13%); they could earn income from using other people's land by selling their products (13%), and other reasons as shown in Figure 1.



Left: Welcome by village head in Suco Aubeon and Introduction to FGD activities.

Number of Plots of Cultivation Land Owned and Used

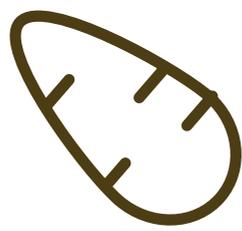
The maximum plots of cultivation land owned by households were six, but the average was two plots of cultivation land per household. For those who used other people's cultivation land, the maximum plots used was four, but the average number of cultivation land used was two plots, which is the same average as using one's own cultivation land. The average number of plots cultivated in a season, regardless of ownership, might be indicative of labour constraints and other inputs available to farmers.

Crop Production



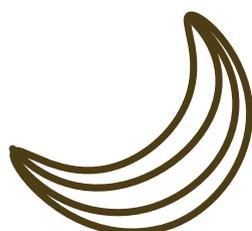
31%

Maize



27%

Cassava

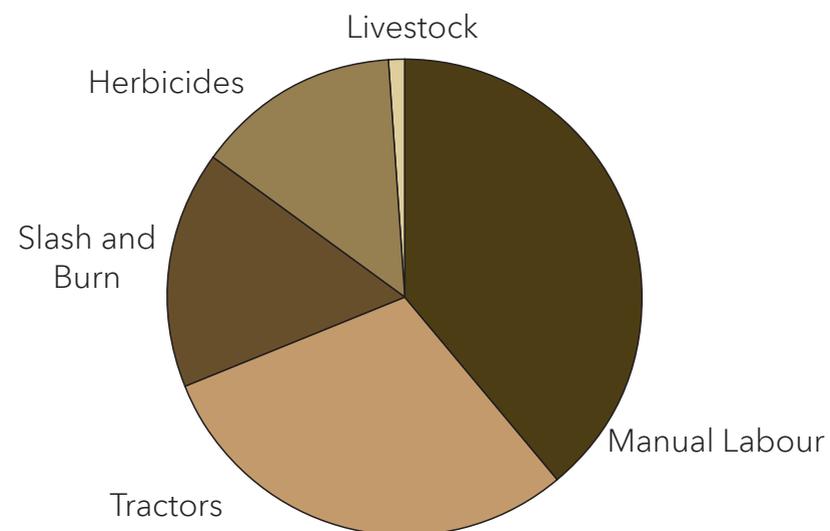


15%

Banana

Most respondents planted crops in the previous cropping season in 2018 (82%). The top three crops planted were maize (31%), cassava (27%) and banana (15%). Although rice is a staple food crop grown on the lowlands of Natarbora, respondents stated they had poor access to tractors and broken infrastructure which prevented them from cultivating wet rice for the past several years.

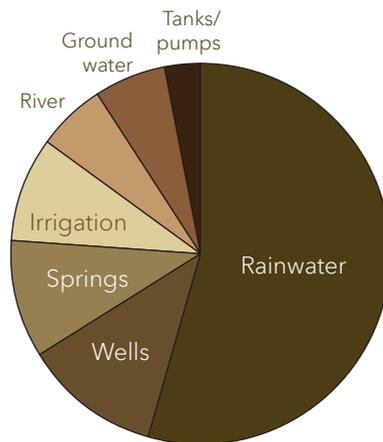
Land Preparation and Agricultural Inputs



In term of land preparation, 39% of respondents used manual labour, 31% used tractors, 16% applied slash and burn technique, 14% applied herbicides and only one percent of respondents used livestock. During the Portuguese times, fields were prepared by hand tools such as machetes and hoes. Hand tractors and larger tractors were only introduced in Natarbora under Indonesian rule.

Fifty percent of respondents did not apply any inputs to increase production or reduce labour and time in the field. Herbicide was the most popular input used (27%) followed by pesticides (14%). Very few farmers applied chemical fertilizers (6%) and organic fertilizers (3%). FGD participants stated that farmers in Natarbora did not use any inputs during the Portuguese and Indonesian times.

Water Sources for Agriculture



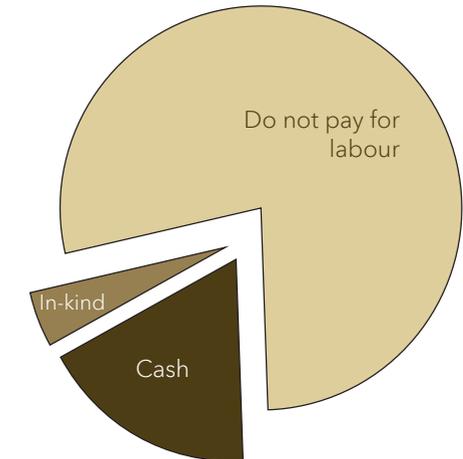
The most common source of water for farming was rain fed (55%). Other common water sources included wells (12%), springs (10%), irrigation channels (9%), river (6%) and ground/bore water (6%). Three percent of respondents used water from tanks or electric pumps (*sanyo*). This region moreover is characterised by what respondents referred to as “moist land” (*rai matak*), which is fertile and can be cultivated throughout the year.



Left: Discussing with Lia Nain at Suco Aubeon, near tara bandu site.

Agricultural Labour and Remuneration

The top three responses for labour used in cultivation were: the respondent (35%), respondent’s spouse (33%), and members of the HH (20%). There were low percentages of respondents who paid for labour (22%). Of those who paid for labour, 80% paid by cash and only 20% paid in-kind.



Along with land preparation techniques, inputs, and crop varieties, paying for agricultural labour appears to be a transformation in Natarbora farming practices. According to information collected from FGDs, Natarbora farmers used to pay in-kind for labourers who worked on their farm or they worked in groups based on mutual reciprocity (typically called “*gotong royong*” for communal work exchange). However, nowadays, even if they belonged to any farming groups, they preferred to pay for labour during the cropping season as an

incentive to ensure that planting is completed on time. The cost of paying labour to work in wet rice cultivation and on dryland fields varies across the three villages and for specific tasks (e.g., planting, weeding, and harvesting), ranging from \$2USD to \$5USD per worker per day. Tractor hire also incurred a cost of \$40USD-\$70USD/ha and \$1USD-\$2USD/litre of fuel.

Major Crops Production and Sale

Crop production and sale data were collected at a plot level per household. Data was then analysed by crop types. There were repeated respondents with different crops but there were no repeated respondents with same crops.

Of the three major crops planted, the maximum yield of maize harvested was 4 ton/ha. Average maize production recorded in Aubeon was 1.1 ton/ha, 1.4 ton/ha in Sicone Diloli and 0.8 ton/ha in Uma Bocu. Total average maize production in the three villages was 1.1 ton/ha. Maize varieties cultivated in Natabora has changed over time.

Cassava and banana production were difficult to measure because farmers did not systemically calculate how much they harvested. For example, a common response to harvesting cassava was as follows:

“We do not know exactly the total harvested because we harvest when we need or once a week. The total quantity harvested is sometimes one basket, sometimes one sack or sometimes just one or two tubers to feed pig”.

Similarly for banana, most respondents did not count how much they harvested. Some respondents stated that they harvested when buyers came to buy from them by truck.

However, not all farmers who planted in the previous cropping season sold their crops. For those who cultivated crops on their own cultivation land, only 41% sold their crops and for those who cultivated crops on other people’s land, only 8% sold their crops. The top three crops sold reflected the top three crops planted by respondents: maize (33%), cassava (17%), and banana (11%). There were also other few crops sold, as listed in Table 8 below.

Crops sold in the previous cropping season (own land)	Aubeon (%)	Sicone Diloli (%)	Uma Bocu (%)	Total (%)
Maize	25	31	39	33
Cassava	17	22	11	17
Banana	4	13	13	11
Eggplant	8	5	7	7
Taro	8	4	7	6
Mustard Green	13	4	2	5
Rice	4	0	9	5
Sweet Potato	4	5	4	5
Yard Long Beans	8	4	0	3
Peanut	0	2	4	2
Lettuce	8	0	0	2
Pumpkin	0	2	2	2
Chilli	0	2	0	1
Lemon	0	2	0	1
Pineapple	0	2	0	1
Tomato	0	2	0	1
Velvet Bean	0	2	0	1
Watermelon	0	0	2	1

Table 8: Crops sold in the previous season from using own cultivation land, sorted by villages.

This was the identical finding for respondents who used other people’s land. The top three crops they sold were maize, cassava and banana.

Most of the crops were sold from home, with buyers approaching sellers (43%), and the buyers were from different places. Some may come from Maubise, Dili, Viqueque or elsewhere, but they did not make arrangements or contracts for sale in advance. The second largest percentage of respondents sold their crops in local markets (36%). The main market in Natarbora situated in Uma Bocu opened every Friday afternoon until Saturday morning. Only 8% had contractors, such as FAO, MAF or some friends from Dili to purchase their crops. Five percent sold their crops in the village, 4% sold their crops in Dili and 4% sold in other municipality markets, such as Manufahi and Viqueque. The detail from each targeted village is listed in Table 9 below.

Where do you sell your products?	Aubeon (%)	Sicone Diloli (%)	Uma Bocu (%)	Total (%)
Sell at home	72	26	48	43
Local market	7	50	36	36
Contractor buy at home	0	9	10	8
Sell around village	21	3	0	5
Dili market	0	6	3	4
Municipality market	0	6	3	4

Table 9: Identifying market for selling crops products.

Regarding who sold the crop products within households, the most common response was female adults (59%), followed by male adults (32%), male children (5%) and female children (3%).

Wet Rice Cultivation

As described in Table 10 below, 63% of respondents cultivated rice in the last cropping season. Aubeon and Uma Bocu had higher percentages of respondents who cultivated rice than Sicone Diloli. The men’s FGD in Uma Bocu highlighted that wet rice cultivation in Natarbora has transformed over time, including the use of different varieties and fertilisers, and the opening of new irrigation systems.

Did you grow rice in the previous season?	Grow rice (%)	Did not grow rice (%)
Aubeon	69	31
Sicone Diloli	48	52
Uma Bocu	64	36
Total	63	37

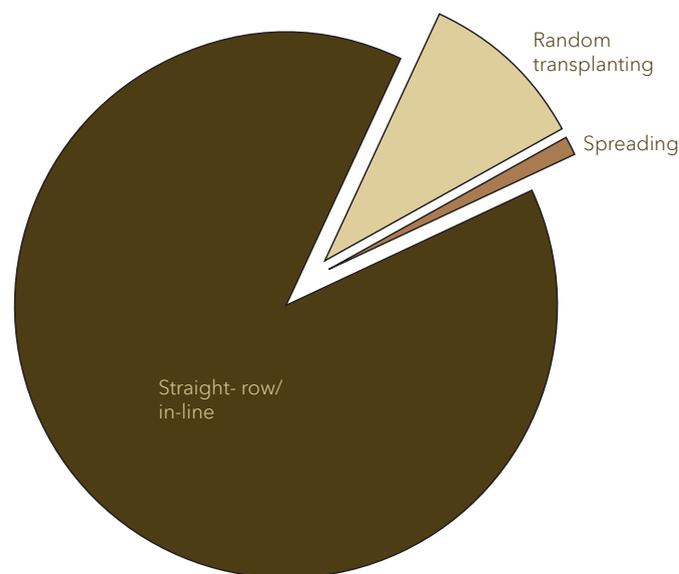
Table 10: List of respondents who cultivated rice in the previous cropping season, sorted by targeted villages.

In terms of frequency of planting wet rice, 78% of respondents cultivated rice once a year, 17% cultivated rice twice a year and 5% reported that they sometimes cultivated rice once a year and sometimes twice a year, as described in Table 11.

Frequency of growing rice	Once a year (%)	Twice a year (%)	Sometimes twice a year (%)
Aubeon	88	10	2
Sicone Diloli	81	19	0
Uma Bocu	69	23	8
Total	78	17	5

Table 11: Frequency of growing rice in the previous cropping season, sorted by targeted villages.

The most common wet rice cultivation method used amongst respondents in Natarbora was straight row/in-line (89%), random transplanting (10%) and spreading (1%).



The top three reasons for not cultivating rice in the previous season were due to respondents who did not own or have access to rice fields (37%), did not have time and labour (33%) and tractors were broken (17%).

Out of the respondents who did not cultivate rice in the previous season, most in Aubeon reported that they did not have rice fields (68%). As discussed earlier in the Introduction, Aubeon was a transmigration area established in the 1990s during the Indonesian occupation. Information collected in the FGDs in Aubeon showed that all transmigrants were supposed to have been allocated 2ha of land. Although transmigrants were allocated 1ha of residential land upon resettlement in 1994, the war which ensued at the end of the Indonesian occupation in 1999 meant that a large

number of transmigrants had not been allocated another 1ha of cultivation land. Land ownership therefore remains contentious in Aubeon. Additionally, some respondents used to cultivate rice in the paddies of customary landowners but the landowners have since taken the land back and rented it to a Chinese agricultural company. Therefore, those farmers that used to grow rice on the landowner's land now depend on livestock and maize for livelihoods and income. Some farmers worked as labourers for the Chinese company.

Unlike Aubeon, Sicone Diloli's respondents stated that their biggest constraint in wet rice cultivation was tractor access (53%). Respondents stated that they used to be able to rent tractors at a subsidised fee, supported by a non-governmental organisation (NGO) CARITAS as well as MAF. However, after the tractors broke down, neither CARITAS nor MAF had fixed the tractors. Some respondents even blamed the Timor-Leste government, citing,

"The main problem is the government has not fixed the tractors yet. Therefore, we cannot grow rice because we normally use tractor to plough our land. We are no longer using animals to plough our land. We have stopped growing rice since 2004 because of tractor problem".

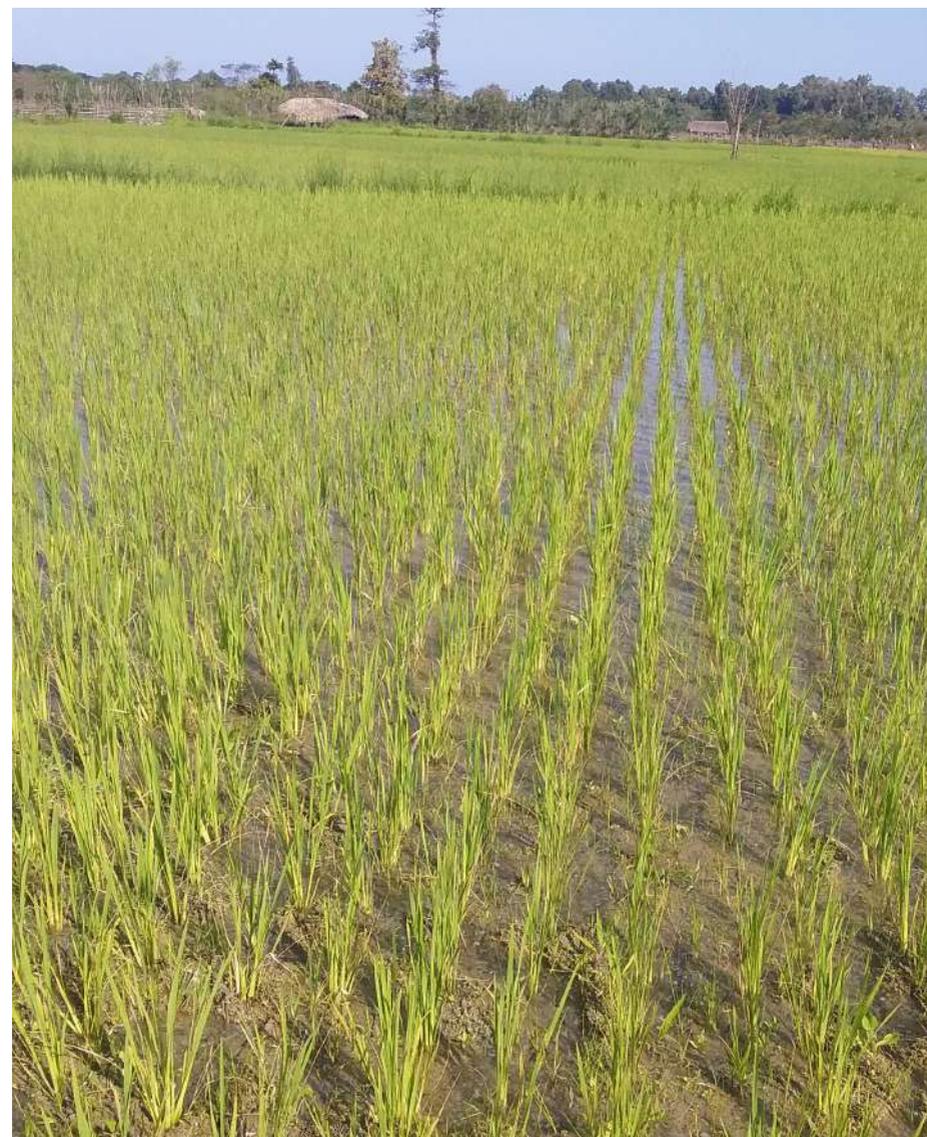
Most of Uma Bocu's respondents had rice fields but did not have time and labour (52%). Additionally, the population in Uma Bocu village was comprised of both customary landowners and migrant settlers. The presence of migrants, and accordingly their lack of rice fields was reflected in the reasons why 26% of respondents did not cultivate wet rice in the previous cropping season. The third top reason was due to problems with irrigation (19%), as described in Table 12 below.

Reasons for not growing rice in the previous cropping season	Aubeon (%)	Sicone Diloli (%)	Uma Bocu (%)	Total (%)
No time and labour	12	41	51	36
Do not have rice field	68	6	26	33
The tractor has broken	5	53	4	17
Irrigation problem	5	0	19	10
Animal control issue	5	0	0	2
Rented to a Chinese company	5	0	0	2

Table 12: Reasons for not growing rice in the previous season.

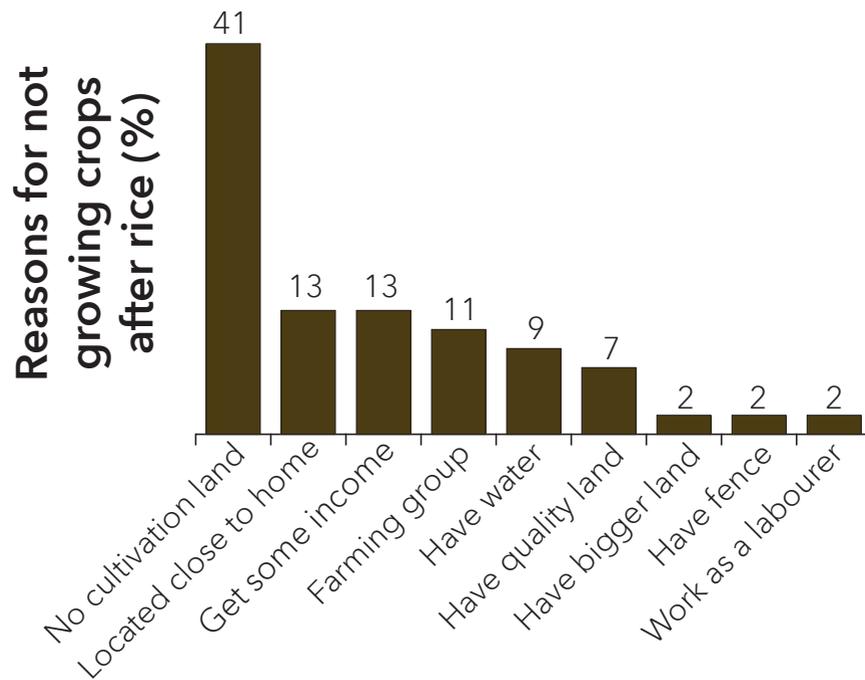
Growing Crops after Rice

Among respondents who planted rice in the previous season, only 20% planted other crops after rice and 80% left their land fallow. The 20% of respondents were from Uma Bocu and Aubeon. The most common crops planted after rice was maize, followed by soybean, mung bean and yard long bean.



Above: Lands have multiple crop use, such as this one, which currently grows rice.

Reasons given for not growing other crops after rice were due to farmers not having time and labour (38%), lack of water (26%), animals roaming freely (12%), as well as other reasons listed below in Figure 2.



Some respondents stated that they did not have time and labour to grow rice twice a year because after rice is harvested, they had to continue preparing to plant dryland crops such as maize, cassava, sweet potato and taro. Furthermore, they did not have enough labour to grow rice simultaneously, as they need to be in the rice fields to watch for pests. Furthermore, farmers needed additional labour when the rice fields are located far away from their residence.

Lack of irrigation was the biggest constraint for rice farmers in Aubeon and Uma Bocu as they have large rice fields.

According to observations, low water volume in the first planting season means that the water volume is lesser during the second planting period. In particular, rice fields located far from the river tended to face irrigation problems.

There were farmers who decided not to grow other crops after rice because of free grazing animals. A reason cited by respondents included:

“We do not want to grow any crops after rice because we do not want to waste time building fence on farming area,”

implying the farmers’ need to control free roaming livestock. By contrast, there were also farmers who preferred to leave their rice fields fallow to improve soil fertility. These farmers in turn intentionally let their cattle roam in their fields. Therefore, fences are needed to prevent livestock from entering fields, or to fence up livestock.

Some farmers reported that they were unable to grow other crops after rice because there was too much water in their rice fields. Some of the reasons cited are as follows:

“We wanted to plant maize after rice but we are afraid that the plant will die because of too much water in the rice field”.

“Our rice field is suitable for rice only. We cannot grow other crops after rice”.

For some respondents, they wanted to grow other crops after rice, but they were not the landowners. They could only grow rice if they were given permission. There were also rice farmers who were forced to quit growing rice since 2017 because the landowners rented the rice fields to a Chinese company, Long Ping High Tech, to grow horticulture crops.

Some rice farmers could be named “seasonal rice farmers” as they depended on other people and agencies to facilitate the conditions for wet rice cultivation. These farmers stated that they had quit growing rice because their working group ended. As one respondent explained,

“the program on planting rice has ended, and nobody provide tractor for us to plough our rice field. Therefore we stopped growing rice.”

Livelihoods and Main Income Sources

Main Employment and Remuneration

As listed in Table 13, most survey respondents were self-employed as farmers on their own land (66%), those engaged in housework (11%), public servants (7%), agriculture labourer (5%), business (5%) and other forms of employment.

Main Job and Remuneration	Cash	In-Kind	Nothing	Total
Agriculture own land	13	90	0	66
Housework	0	3	89	11
Public servants	35	0	0	7
Agriculture labourer	0	8	0	5
Business	26	0	0	5
Petty business	19	0	0	4
Manual labour	6	0	0	1
Not working	0	0	11	1

Table 13: Respondents main employment and remuneration sorted by payment method.

In terms of remuneration, 71% of respondents received in-kind payments. This corresponds to the high percentage of respondents working in the informal economy as farmers, domestic workers and farm labour. Only 18% received cash payment and 11% did not receive any payments because they provided mutual assistance.

Social Cash Transfers from the Government

The Timor-Leste government has established several social cash transfer schemes. These are namely: *bolsa da mae* (for students who are raised by single parents and in households with low financial income), aged pension (for elderly aged 60 and over), veteran pension (for individuals (or if deceased, their descendants) who contributed to the national independence movement) and other cash transfers schemes, such as for people with disabilities. Direct cash transfers can supplement their income and shoulder beneficiaries from economic hardship.

As described in Table 14, 52% of surveyed households benefited from *bolsa da mae* for their children. Thirty one percent of households received aged pensions, 13% received veteran’s pensions and 4% received other forms of cash transfers.

Does anyone in your household receive the following?	Bolsa da Mae (%)	Aged Pension (%)	Veteran Pension (%)	Others (disability, etc) (%)
1 person/HH	11	21	12	3
2 people/HH	14	8	1	1
3 people/HH	22	2	0	0
4 people/HH	1	0	0	0
5 people/HH	2	0	0	0
6 people/HH	1	0	0	0
7 people/HH	1	0	0	0

Table 14: Household members who received social cash transfer from government, sorted by total respondents who benefited from social cash transfers.

Absent Family Members and Remittances

Fifty-three percent of respondents stated that they had family members who were absent for more than 3 months. Most of these absentee family members were attending school elsewhere (64%). Therefore, their households did not receive any remittances. Instead, these family members were supported by their parents and relatives. Twenty-seven percent of households reported family members working in Dili (48%), other districts (43%), or abroad (9%). An estimated 27 youths in Aubeon village went to South Korea, England and Australia to work at the time this survey was conducted (source: Men’s focus group in Aubeon, 28 August 2018). Only 16% of households with absent members received remittances (money and gifts) from their family members who were working in other places, as described in Table 15.

Occupation of absent family member	Total (%)	Send money home (%)	Send gift home (%)
Go to school	64	0	0
Working	27	16	16
Doing nothing	7	0	0
Married	1	0	0
Labour work	1	0	0
Look for job	1	0	0
Petty business	1	0	0

Table 15: Occupation of absent family members, and those who sent money or gift home, sorted by total responses that have family members away for more than 3 months.



Above: Survey with a household head.



Micro-Credit and Loans Services

Knowledge of micro-credit and loans services was low among respondents (41%).



Are there micro-credit services or informal loans available in your community	Aubeon (%)	Sicone Diloli (%)	Uma Bocu (%)	Total (%)
Yes	33	36	49	41
No	67	64	51	59

Table 16: Access to micro-credit services or informal loans available in the village.

Among those who knew about micro-credit services, they stated that such services were provided by banks (38%), NGOs/agencies (25%), saving and loans cooperatives (12%), Timor-Leste government (12%), family or friends (7%), and finally, those who did not know the sources of such services (6%).

Left: Enumerator training to conduct household questionnaire using ODK software on Android tablets.

Household Livestock Production

Almost all respondents in the target villages raised livestock (98%). The number of respondents who raised livestock is higher than those who cultivated crops in the previous season (which only reached 82%).

Do you raise livestock in the last twelve months?	Raise livestock (%)	Did not raise livestock (%)
Aubeon	98	2
Female	100	0
Male	97	3
Sicone Diloli	100	0
Female	100	0
Male	100	0
Uma Bocu	99	1
Female	100	0
Male	97	3
Total	98	2

Table 17: Respondents who raised livestock in the last 12 months, sorted by targeted villages.

As listed in Table 18, the highest number of livestock reared by households were chicken (35%), pigs (31%), and cows (28%). By raising livestock, respondents were able to attend to cultural exchanges and sell livestock to buy daily needs, pay for school fees or buy secondary needs and rebuild

their houses (sources: FGDs in the three targeted villages held between 27 to 29 August 2018).

Across all three villages, men generally looked after larger livestock, such as buffaloes, cattle and goat. Women typically looked after smaller livestock, such as pigs and chickens.

What livestock did you raise in the last 12 months?	Chicken (%)	Pig (%)	Cow (%)	Goat (%)	Buffalo (%)	Fish (%)	Horse (%)
Aubeon	34	29	30	6	1	0	1
Female	32	32	29	6	1	0	1
Male	36	27	30	6	0	0	1
Sicone Diloli	34	29	30	4	1	1	0
Female	34	30	30	4	0	1	0
Male	35	27	31	4	4	0	0
Uma Bocu	36	33	25	3	2	1	0
Female	37	33	23	2	3	1	0
Male	36	33	27	3	0	1	0
Total	35	31	28	4	1	1	0

Table 18: List of livestock reared by respondents, sorted by targeted villages.

According to field observations, FGDs and interviews with local leaders and fish farmers, rearing fish or shrimp has become a livelihood activity that attracted community members since there was a demand for fish (e.g., sold to prepare meals for students in local schools).

Participation in Agricultural Innovations Programs

Fifty percent of respondents had participated in one or more agricultural innovation programs (see Table 19). Most respondents had only participated in one type of program (61%), followed by two types of programs (22%). Only 10% of respondents had participated in three types of programs, 5% had participated in up to four types of programs and only 1% of respondents had participated in five types of programs.

Village	Agricultural Innovations Program Participated	
	Participated (%)	Not Participated (%)
Aubeon	62	38
Female	52	48
Male	71	29
Sicone Diloli	45	55
Female	46	54
Male	44	56
Uma Bocu	43	57
Female	38	62
Male	47	53
Total	50	50

Table 19: List of respondents who participated in agricultural innovation programs implemented, sorted by targeted villages.

The types of agricultural innovations programs that respondents participated in the three targeted villages were: new agricultural techniques (26%), natural resource management (22%), new crop varieties (17%), commercial seed production (15%), conservation agriculture (14%) and irrigation program (6%) (see Table 20).

Agricultural innovations program participation	New technique (%)	NRM (%)	New crop varieties (%)	Commercial seed production (%)	CA (%)	Irrigation (%)
Aubeon	26	28	15	16	6	9
Female	29	29	21	13	4	4
Male	25	27	11	18	7	11
Sicone Diloli	13	17	22	13	26	9
Female	14	21	21	7	29	7
Male	11	11	22	22	22	11
Uma Bocu	33	15	17	15	20	0
Female	35	10	25	10	20	0
Male	31	19	12	19	19	0
Total	26	22	17	15	14	6

Table 20: Types of agricultural innovations programs participated by respondents, sorted by targeted villages.

New Agricultural Techniques

Some of the new agricultural techniques programs respondents joined included learning how to drive tractors from NGO CARITAS, planting rice in straight rows, and new techniques to grow horticulture crops. More respondents continued to apply these new techniques (58%) than those who stopped applying (42%) when the programs terminated. Some reasons given for continuing to apply new agricultural techniques included,

"It helps to count seeds needed to grow easily"

"Helps to increase yield and income"

"When applying in line planting technique, able to save more seeds"

Reasons given for not applying new learned techniques included,

"The program has been terminated"

"Stopped growing rice"

"No resources, labour or time"

Natural Resource Management (NRM)

In total, 22% of respondents participated in NRM programs. Some NRM programs stated by respondents included raising fish and livestock; planting coconut and mangroves (specifically in Aubeon village - a conservation initiative led by the United Nations Development Program (UNDP) to preserve mangrove areas). Additionally, there was also *tara bandu*, a customary NRM practice widely applied across Timor-Leste which was implemented in the target villages. Village regulations established under *tara bandu* covered all aspects of village life pertaining to 1) people to people relations, 2) local livelihoods, and 3) the protection of natural resources. For example, community members are encouraged not to cut trees illegally, fish or hunt arbitrarily, and not

to let their livestock roam freely (i.e. to protect the environment and minimise damage or destruction of people's crops and property).

Seventy percent of respondents continued to apply this program. The reasons given by respondents who continued to apply NRM principles included: 1) able to conserve environment, 2) no need to build fence on farming areas and kill animals due to better animal control, 3) no more illegal tree cutting and 4) able to increase income.

Some respondents stated that they had stopped applying NRM principles because the programs have ended or were abandoned.

***Tara Bandu* Practices**

In Natarbora, all three villages had customary authorities (mostly men) who regulated natural resource access and management. *Mak Lehat* is an environmental steward who governs access to terrestrial natural resources, such as forests, non-timber tree products, as well as wild animals. *Mak Sabar* is similarly an environmental steward who regulates marine resources, including sacred spring, mangroves and marine animals, and they conduct rituals near the sea. These two positions are inherited through one's origin 'house'.

Although *tara bandu* was locally enforced in the three villages for nearly a year at the time the survey was conducted, many respondents stated that it was not fully effective since livestock and hunting wild animals were important sources of food security, livelihoods and income.

Cultivating New Varieties

Seventeen percent of respondents participated in cultivating new crop varieties. Some respondents participated in planting mahogany through a program run by a local NGO Halarai and some respondents highlighted new maize varieties, "noi mutin" and "sele", that they obtained through Seeds of Life program. Forty eight percent of respondents continued cultivating new crop varieties. Respondents who continued to plant mahogany explained that they participated in the above program to increase their production and income. Those

who continued using "noi mutin" and "sele" stated that there was a market demand. Reasons cited by those who stopped included: they had run out of seeds/seedlings; the program ended; and they had no empty land to grow the new varieties.



Above: Tara bandu in Suco Aubeon.

Commercial Seeds Production

Fifteen percent of respondents participated in commercial seeds production. Seeds produced commercially included rice, mung bean and maize (*noi mutin* and *sele* varieties). Some respondents continued to produce commercial seeds as it increased their production and income. They also had a reliable link to market through their partnership with MAF who bought directly from them. There were 43% of respondents who continued to participate

in this program and 57% who quit. Reasons given for continuing to produce commercial seeds were because there was a market demand, to save the seed store plant again in the following year and to earn an income. Reasons given for not producing commercial seeds any longer included farmers running out of seeds, the commercial seed production group had ended due to no market demand, and farmers not having enough time.

Conservation Agriculture

Conservation agriculture (CA) established by FAO was introduced in the villages by cultivating velvet bean with maize to improve soil fertility and increase maize production. CA program participants were encouraged to adopt the three CA principles: 1) not to burn the land before cultivation, 2) not to plough the land with big tractors, and 3) to use mulch (such as velvet bean leaves to cover the ground). Fourteen percent of respondents participated in this program. Sixty seven percent of these

participants continued using CA but 33% had quit. Reasons for continuing to apply CA included increased production, improved soil fertility and reduction in burning the land in preparation for cultivation. The main reasons for not applying were mostly because the group had ended and respondents were afraid of snakes (from ground cover growth).

Source of Program Implemented

The six types of agricultural innovations programs highlighted above were mostly implemented by international NGOs (37%), the Timor-Leste government (35%), local NGOs (24%), private companies (3%) and foreign governments (1%) (Figure 3).

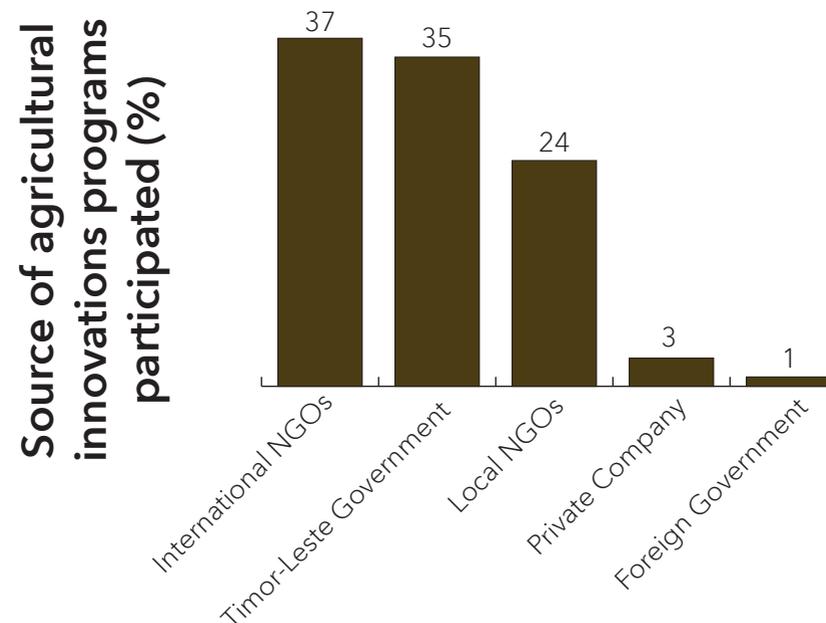


Figure 3: Source of agricultural innovations programs participated.

Plantation Ownership

Timorese families typically have access or ownership to plantations of fruit, coffee, betel nut, and high-value tree crops. As indicated in Table 21 below, 44% of respondents stated that they had plantations and 56% did not.

Do you have plantation?	Have plantation (%)	Do not have plantation (%)
Aubeon	26	74
Female	33	67
Male	21	79
Sicone Diloli	61	39
Female	63	38
Male	56	44
Uma Bocu	51	49
Female	56	44
Male	44	56
Total	44	56

Table 21: List of respondents' answers of having plantation or not, sorted by targeted villages.

As listed in Table 22, most respondents' plantations are mainly comprised of teak (39%), coconut (12%) and mango (8%).

Plantations owned	Aubeon (%)	Sicone Diloli (%)	Uma Bocu (%)	Total (%)
Local teak	58	32	37	39
Coconut	4	10	16	12
Mango	0	10	9	8
Betel nut	4	8	8	7
Mahogany	27	2	1	6
Philippines teak	0	2	8	4
Banana	4	5	3	4
Jack fruit	0	5	4	4
Candle nut	0	2	5	3
Cashew	0	5	1	2
Papaya	0	5	1	2
Coffee	0	2	3	2
Rambutan	4	0	3	2
Water apple	0	5	0	2
Bread fruit	0	3	0	1
Orange	0	3	0	1
Avocado	0	2	0	1

Table 22: List of plantations owned, sorted by targeted villages.

Do you grow any trees on your cultivation land?	Aubeon (%)	Sicone Diloli (%)	Uma Bocu (%)	Total (%)
Yes	89	85	75	82
No	11	15	25	18

Table 23: Respondents who planted trees on their cultivation land, sorted by targeted villages.

Reasons for growing new tree varieties	
Mahogany	"A project provided the tree for us therefore we planted it".
	"Have high value in the market"
	"Someone shares it for free, therefore we planted it"
Rambutan	"Because the tree provides us shade and fresh air"
	"Because it has high value in the market"
Fig trees	"Just wanted to try"
	"It is recommended to plant as a traditional medicine, to cure stomachache, and can produce tea out of it"
	"This fig tree has lots of benefit to us. Could be use as traditional medicine. Leaves and fruits also have value in the market"
Orange	"We planted to invest for our kids to be able to harvest and sell in the future"
	"We want to improve our income by selling orange in the near future"
	"Have value in the market"
Local teak	"Have value in the market therefore we wanted to plant for our kids to be able to harvest in the future"
Teak (Philippines)	"To sell in the future"

Table 24: Reasons for growing new tree varieties.

Although most respondents did not have plantations, they did plant tree crops on their cultivation land (82%), as shown in Table 23. The top three tree crops varieties planted mirrored the varieties planted on respondents' who owned plantations; these were local teak (16%), coconut (15%) and mango (12%), and the others (Table 30).

Sixteen percent of respondents had tried to plant new trees species. These included rambutan (33%), fig (19%), mahogany (19%), local teak (7%) and the others (Table 31). The tree seedlings for these new varieties were obtained from family/relatives (48%), NGOs (26%), friends (15%), purchased (7%) and MAF extension officers (4%).

Diverse reasons, including economic and personal, were given by respondents as to why they decided to plant new tree varieties. These reasons are cited in Table 24.

In terms of contribution to household income, only 37% of respondents sold their tree crops or tree products. Sixty-three percent were unable to sell as their tree crops and tree products were still immature and unable to be harvested. The top tree crops or tree products sold were betel nut (27%), local teak (23%), banana (13%), and some others (see Table 25).

If yes, what trees or tree product do you sell?	Aubeon (%)	Sicone Diloli (%)	Uma Bocu (%)	Total (%)
Betel nut	38	20	25	27
Local teak	10	40	14	23
Banana	19	10	11	13
Mango	10	17	11	13
Papaya	5	0	14	6
Coconut	0	7	4	4
Orange	10	3	0	4
Rambutan	10	0	4	4
Mahogany	0	3	4	3
Philippines teak	0	0	7	3
Bread fruit	0	0	4	1
Candle nut	0	0	4	1

Table 25: List of trees or trees products sold, sorted by targeted villages.

Timber and tree products were mostly sold from home (54%) (i.e. buyer approaches to seller) and local market (39%). Only 5% sold timber and/or tree products in Viqueque and Manufahi markets and 1% sold in Dili market.

Table 26 below provides teak prices across the three villages. Mahogany was recently introduced in the villages and as yet not commonly sold.

Village	Teak	Mahogany
Uma Bocu	6/12 - 1 cubic (30 units): \$300 5/7 - 1 cubic (42 units): \$350	--
Sicone Diloli	They do not sell by volume but sell by logs (\$30-\$50). They first planted in 2006 and started selling in the past few years.	No one has sold yet.
Aubeon	They do not sell by volume but sell by logs (\$50-\$70). People buy from within Aubeon, for example, carpenters and those who build houses.	They know people who sell mahogany, but they do not know them personally or the sale price.

Table 26: Timber prices in the three villages.

Source: Men's and Women's Focus Group Discussions held from 27 to 29 August 2018.

Interest in Planting Sandalwood

No survey respondents had sandalwood plantations and only 1% of respondents stated that they have tried to grow sandalwood. Nevertheless, 82% of respondents expressed an interest to trial sandalwood if they were able to obtain seedlings. The reasons for wanting or not wanting to trial sandalwood included the following:

Why do you want to grow sandalwood tree?	Total (%)
Have high value in the market	42
Invest for future use or income	28
It is provided freely	12
Have empty land	6
It is native to Timor	4
Want to learn about how to grow sandalwood tree	4
Want to try	3
Want to grow in hometown	1

Table 27: Reasons for wanting to grow sandalwood trees.

Among the minority of respondents who did not want to grow sandalwood, they stated that they were confused or could not decide either to grow or not (38%). Twenty-three percent of respondents did not want to grow sandalwood because they did not have land. Some respondents do not have time and labour (20%) and other reasons as listed in Table 28.

Why did you not want to grow sandalwood trees?	Total (%)
Do not know	38
No land	23
No time and labour	20
Takes too long time to harvest	10
Cannot grow mixed with other annual trees	3
Low land area is not suitable for sandalwood	3
Wanted to grow teak	3

Table 28: Reasons for not wanted to grow sandalwood tree.

Extreme Weather Events and Seasonal Variations

According to women participants in the FGDs, Natarbora has experienced extreme weather events and climatic variations in the past five years. Respondents in FGDs highlighted heavy rains and flooding in 2013 and 2015, whereby the rivers rose, and flood water entered houses, washing away household items as well as livestock. The Red Cross and Ministry of Social Solidarity (MSS) helped, distributing to households such as rice, oil, blanket and other household items but not monetary compensation.

Strong winds were reported by respondents in Uma Bocu in May 2016 and 2017. The winds damaged a few houses and destroyed staple crops. Each family received \$150 and corrugated iron sheets to rebuild houses. Some families had not received any government assistance at the time of conduct this survey. Strong winds were similarly reported to have occurred in January 2018 by respondents in Sicone

Diloli. Households whose properties were damaged registered with MSS, however, they had not received any assistance during the time this survey was undertaken.

Respondents in Sicone Diloli stated that the dry season has become extended through to October and November in the past five years. When the dry season is prolonged, water in Sicone Diloli dries up, and women must fetch water from We Inan river in the old growth forests. Respondents explained that the water used to dry up in August, but nowadays, rain continues until August before the dry season starts.

Discussion and Conclusion

Most respondents in Natarbora are self-employed small holder farmers who make a living from raising livestock (98%) as well as cultivating crops (82%). The top three crops cultivated and sold were maize, cassava and banana. ***Selling timber or forest products is not a well established income source.***

Despite experiencing past forced resettlement, land tenure is not the main challenge for farmers. In fact, 93% of respondents grew crops on their own cultivation land and 82% cultivated crops in the previous cropping season in 2018. ***Although most respondents depend on rain-fed farming, use minimal inputs, manual labour and tractors to cultivate their land, there has been changes in land preparation techniques, inputs used, labour remuneration and crop varieties in both dryland and wet rice cultivation in Natarbora from the Portuguese times until present.*** Herbicides followed by pesticides are the most popular inputs used. Agriculture labour is predominately performed by household members and paid in-kind. Increasingly, labour hire is used, and payment is monetised, ranging between \$2USD to \$5USD per worker per day. Additional costs are associated with tractor hire (\$40USD- \$70USD/ha) and fuel (\$1USD-\$2USD/l).

Although rice is a staple food crop cultivated on the south coast, rice was not listed as one of the major crops cultivated or sold by respondents. ***Respondents across the three villages stated they had poor access to tractors***

Therefore, the introduction of dry season agricultural innovations should foremost be labour and time saving, require minimal water, and or be accompanied by irrigation rehabilitation, as well as address the problem of free grazing animals.

and poorly maintained basic infrastructure, which have prevented them from cultivating wet rice for several years.

Although the Timor-Leste government fully subsidised fuel for tractors in the three villages, this initiative stopped in 2017. Hence, only people who can afford to pay for fuel and tractor hire can cultivate wet rice. Even when fuel was provided for free, this was not enough for all farmers. Tractors can still be borrowed from local NGO ETADEP in addition to tractors provided by MAF, however, the number is insufficient, which results in farmers preparing their fields late for the cropping season. In addition, the tractors are old and not well-maintained. Sometimes, tractor drivers are reluctant to work as they may not receive their wages. We Kanurak rice fields in Aubeon and Sicone Diloli have irrigation, however farmers have not been able to access them since the road and bridge needs repairing. Similarly, rice fields in Uma Bocu, in an area known as Natarbora, have irrigation problems since 2016 and they have not been repaired. In Aubeon, Kakae Uman rice fields have no irrigation; hence locals dig their own irrigation channels each season.

Among respondents who planted rice in the previous season, only 20% planted other crops after rice and 80% left their land fallow. The most common crops planted after rice were maize, soybean, mung bean and yard long bean. The main reasons given for not growing other crops after rice were due to farmers not having time and labour (38%), the lack of water (26%), and free grazing animals (12%).

Therefore, the introduction of dry season agricultural innovations should foremost be labour and time saving, require minimal water, and or be accompanied by irrigation rehabilitation, as well as address the problem of free grazing animals. Al-Com has conducted further research on animal control methods in Natarbora in December 2019 and will publish findings in 2020.

More generally, farmers faced challenges during the wet and dry seasons. The main challenges of growing crops during the dry season included insufficient rainfall, leading to low crop yield, as well as free roaming livestock eating or destroying crops. During the wet season, farmers can experience too much rain and fields become water-logged. They must manage many pests, including rats and sparrows (specifically, a small bird called *manulin* or sparrows). They must buy pesticides (or make traditional ones) and spend time in their fields to watch over their crops to keep birds away. Natarbora has furthermore experienced extreme weather events, such as floods and gusty winds which have damaged properties, along with extended dry seasons which have disrupted agricultural livelihoods.

All three villages had implemented customary natural resource management, *tara bandu*, by establishing formal village-wide regulations on resource access and use (including restrictions on free grazing livestock,

hunting, illegal logging, stealing, burning, etc.). However, respondents did not think that *tara bandu* was effective in promoting NRM. Specifically, there was a tension between environmental conservation and local livelihood practices. ***Livestock is an important income source and farmers are reluctant to implement costly animal control methods, which are either time-consuming or expensive (e.g., tethering and fencing livestock). Hunting wild animals is considered as a supplementary food source and livelihood activity that generates easy and fast income. Improving NRM will require alignment with communities' livelihood concerns. This could be addressed by conducting more socially inclusive consultations with diverse community members (e.g., those who let their livestock free graze, those who depend on hunting, and those who cultivate crops during the dry season etc., to identify what NRM practices will work best).*** AI-Com's survey on *tara bandu* published in the Velvet Bean Report 2019 found only 45% of respondents in Uma Boco and 68% in Sicone Diloli were involved in the design of *tara bandu* in their village. Aubeon was not included in the survey.

Livestock is an important income source and farmers are reluctant to implement costly animal control methods, which are either time-consuming or expensive (e.g., tethering and fencing livestock).

Appropriate farmer education and training on sandalwood and agro-forestry that considers existing social, economic and environmental conditions is recommended to ensure long term adoption and sustainable outcomes.

Over half of the survey respondents participated in one or more types of agricultural innovation programs, suggesting an openness to agricultural technology adoption through learning new knowledge and skills. Continued application of the learnt knowledge and skills however varied. The most common reason for respondents to quit applying the newly acquired knowledge and skills was program cessation. ***Discontinued innovation adoption or application may indicate either ineffective communication of innovations to farmers or costly access to innovations.***

Most respondents (82%) also expressed an interest to trial sandalwood. In particular, respondents recognised the high market value of sandalwood and its significance as an intergenerational source of income. Respondents who were not interested in sandalwood stated they were either confused or undecided about planting sandalwood, did not have land to plant sandalwood or were sceptical that sandalwood could thrive on the lowlands. ***Appropriate farmer education and training on sandalwood and agro-forestry that considers existing social, economic and environmental conditions is recommended to ensure long term adoption and sustainable outcomes.***

