

Development of Maluku Nutmeg (*Myristica Fragrans* Houtt.): Collaborations, Opportunities and Challenges

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ABSTRACT

Nutmeg (*Myristica fragrans* Houtt.) is one of the few commodities from Indonesia, especially Maluku islands, which are highly demanded in international market for centuries and is the base of an international trading route known as "spice route" where Banda "spice island", Maluku as the center. This study aimed at elaborating the development of nutmeg commodity in its center of origination and cultivation. Data were acquired during implementation of the Blended Learning-Value Chain project, a joint project between Indonesia and Netherlands, nutmeg innovation platform activities, as well as literature research and assessment. Efforts in nutmeg development in Maluku are implemented in inclusive and sustainable manner through collaboration of different institutions and stake holders along the value chain system of nutmeg commodity. Identification of opportunities, challenges and problems together with the way of dealing with them are carried out to be further implemented the findings in the field. Sustainable development is perceived in term of environment and biodiversity, humanity especially related to indigenous community, and continuing profitability and therefore developing a sustainable living.

INTRODUCTION

Nutmeg (*Myristica fragrans* Houtt.), one out of a few spice commodities from Indonesia, are the trigger of development of the world trading sail route called "spice route" since centuries ago with Banda or spice island as the center. The spice road, in turn, becomes the foundation of development of various living sectors including economy as well as science. In the modern era of 21st century, nutmeg is still produced in its center of origin and cultivation; however, it is no more the only producer and exporter of nutmeg products. A number of countries have been the competitors in world's nutmeg exports (Table 1). Similarly, in Indonesia, several provinces have emerged into nutmeg producers even exceed that of Maluku Islands (province) (Figure 1). Meanwhile in Maluku province, the spice island (Banda), which situated in the Central Maluku Regency is no more the only nutmeg producing area; the whole province or 11 regencies in Maluku are now the nutmeg producers in the province (Table 2).

With the increase of competition in nutmeg production and export, increase in marked demand for high quality products, the required quality standards applied to nutmeg products is also increased and have been the cause of many cases of refusal of nutmeg products from Indonesia in international market, especially due to aflatoxin contamination, poisons produced by fungi mostly of *Aspergillus flavus* and *A. paraciticus*.

Development, in many aspects including an agricultural commodity, in recent understanding, requires a tied collaboration among related parties or stake holders such as government, education and research, and business institutions, which is then extended to community and press. A concept, well known as triple helix – quintuple helix is closely related to development in the context of value chain, a newly developed scientific branch of economic science dealing with the movement of a product or service right from its conception to production, marketing, consumption and recycling of the by products, in which, every component or player involved, collaborates to improve the value of the product at every stage of value chain.

Intensive efforts in nutmeg development in Maluku province in recent years have been accomplished in inclusive and sustainable manners involving various related institutions within the nutmeg's value chain, i. e. inclusion of different scientific specialties (agronomy, post harvest technology, agribusiness), business scales (micro, small, medium and big entrepreneurs), area of operations (local, regional, national, international), and at the same time, paying attention on sustaining the environment, human and business profit.

In the implementation stage, it is required to identify opportunities, challenges and problems encountered followed by proposing ways of utilizing the opportunity, facing the challenges and dealing with problems, and continuously identifying new opportunities, challenges and problems to move further ahead.

This paper deals with the development of nutmeg commodity in Maluku islands in recent years covering collaborations among various institutions on the nutmeg's value chain as well as identification of opportunities, challenges and problems faced in the development.

METHODOLOGY

This paper was developed through experiences of implementing an international joint project, in which teaching, seminars/webinars, research and field visitations and discussions with different related parties or players in agricultural value chain specifically on a number of spice and food crop commodities specific to Maluku islands, were carried out. The parties involved covered farmers and farmer's group, collecting traders, family business companies, government institutions or policy makers, educational institutions, research and assessments institutions, in the scale of local, regional, national and international. It was also developed through brain-stormings, presentations, discussions on various aspects related to nutmeg's development during meetings of Maluku Nutmeg Innovation Platform, a platform established as a way of following up or institutionalisation of Blended Learning - Value Chain (BLVC) Joint project after the project's termination. More over, the paper was developed through literature research and assessment.

RESULTS AND DISCUSSIONS

Recent Situation on the production and trading of Nutmeg commodity; International, National and Local

Data of World Integrated Trade Solution (WITS) (2019) pointed out that in the year 2019, there were 84 nutmeg exporting countries with Indonesia being the highest, exporting 16,558.800 kg in a value of 85.918, 23 million US\$. The highest exporting countries were dominated by Asian continent followed by European (Table 1). Nutmeg importing countries in 2019 were

142 with five highest were European Union, Germany, USA, Netherlands and China (Table 1). Analysis of competitiveness in nutmeg's export among five biggest world exporters during 2007 – 2016 (Asrol dan Herianto, 2017) concluded that Indobnesia has the strongest competitiveness in the international market.

At the national level, nutmeg production of Indonesia in 2020 reached 27,4 thousand tons with North Maluku province at the first position producing 8, 56 thousand tons (Biro Pusat Statistik, 2020, Figure 1). North Maluku province was formerly belong to Maluku Province while Maluku province where the spice Island Banda situated, ranked third with the production of 5,86 tons following Aceh provinve with 6,4 thousand tons (Figure 1).

Maluku province produced 5512, 10 tons of nutmeg from community plantations in the year 2017 out of 28360 farmers and 31624.10 ha growing area (Table 2). Nutmeg has been a commodity cultivated in all regencies/municipalities in Maluku province, not only in the spice island, Banda, which administratively situated in the Central Maluku Regency. Dispite being the highest in total production in the province, Central Maluku Regency was slightly behind in production per hectare in comparison to that of Ambon and Tual municipalities (Table 2). A number of factors could be the cause of the discrepancy. Short distance to related government institutions in the cities (Tual and Ambon), which are the capital of the municipality and therefore agricultural aids and services may be one of them, while the disparities in productions within farmers in the regency, which relatively has bigger planting area in addition to cultivation problems and condition of nutmeg trees maybe other reason.

Nutmeg's trading situations in Indonesia in recent years has been merked by the rejection of export products due to inability to meet the food health and savety standarsds as a result of aflatoxin intoxication produced by fungus of the genus *Aspergillus* especially *A. flavus* and *A. parasiticus* (Hafif, 2021; Fauziah dan Zurayah, 2013). Out of 54 rejection cases during 2014 to 2016 in the international market especially Europea Union, USA and Japan, 40 cases were of micotoxin –aflatoxin contamination, 13 others were of incomplete documents and one case of cleanness (Rahayu et al., 2020).

Table 1. Five biggest nutmeg exporting and importing countries in the world in 2019.

No.	Country	Export		Import	
		Total (kg)	Amount Value (Mill. US\$)	Total (kg)	Amount Value (Mill. US\$)
1.	Indonesia	16,558,800	85,918.23	-	-
2.	India	2,489,870	15,995.38	-	-
3.	Sri Lanka	2,657,970	14,450.16	-	-
4.	Netherlands	1,262,040	13,020.86	-	-
5.	Vietnam	1,514,890	12,716.79	-	-
1.	European Union	-	-	4,899,670	37,817.47
2.	Germany	-	-	1,807,900	16,817.72
3.	USA	-	-	2,134,110	14,728.16
4.	Netherlands	-	-	1,522,140	11,551.94
5..	China	-	-	2,398,130	10,973.77

Source: Word Integrated Trade Solution (WITS) (2019).

Table 2. Land area and production of nutmeg community plantation in Maluku in the year 2017.

Regency/Municipality	Area (Ha)	Number of Farmers (Family's head)	Production (Ton)	Production/Ha (kg)
South East West Maluku	13.00	50.00	1.90	146.15
South East Maluku	2769.30	1536.00	457.90	165.35
Central Maluku	11155.40	14521.00	2134.10	191.31
Buru	942.30	557.00	111.20	118.01
Aru Islands	23.00	26.00	4.00	173.91
West Seram	2299.50	826.00	251.10	109.20
East Seram	8831.00	6695.00	1287.20	145.76
South West Maluku	1510.40	1260.00	84.40	55.88
South Buru	2218.80	1600.00	413.40	186.32
Ambon	1763.00	989.00	746.10	423.20
Tual	98.40	300.00	20.80	211.38
Maluku Province	31624.10	28360.00	5512.10	174.30

Source : Maluku Department of Agriculture (Maluku Province in Numbers)

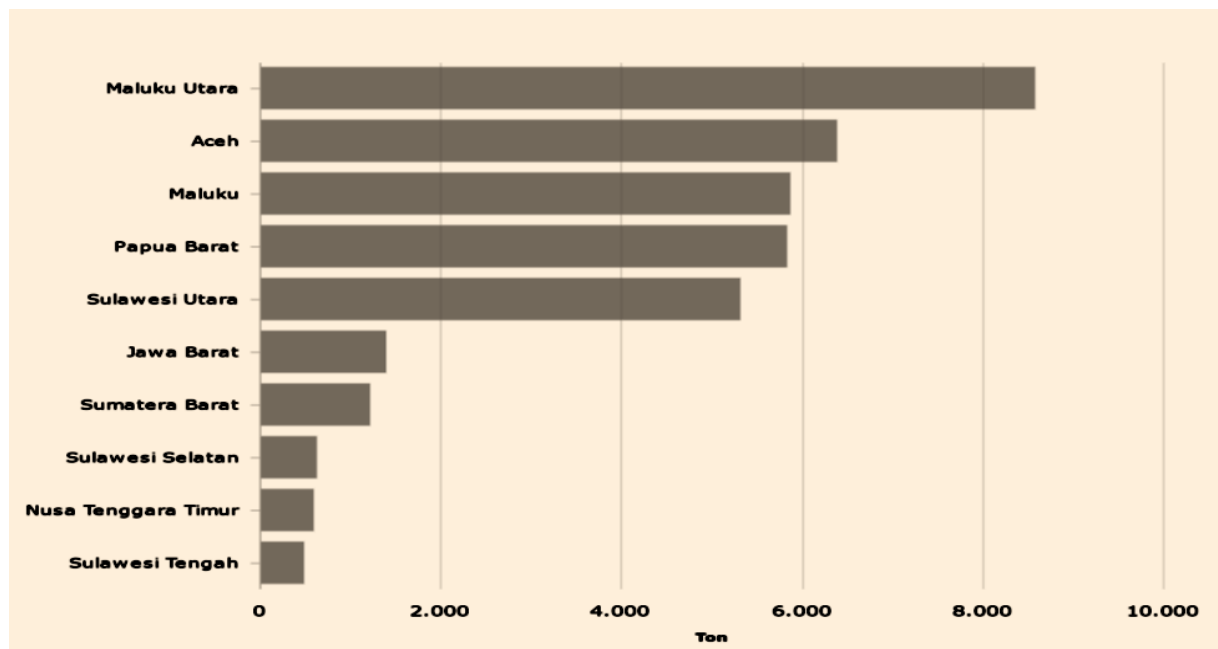


Figure 1. Ten biggest nutmeg producing provinces in Indonesia in the year 2020.

Source: Central Bureau of Statistics (2020)

Collaborations for nutmeg's development in Maluku

Value Chain and trading system before and after the presence of exporting family business companies

Nutmeg cultivation and production have been well developed since many years in all of the regencies and municipalities in Maluku province (Table 2). Without any organized trading system, nutmeg farmers are free to sell their products to any party; village collecting traders or

county collecting traders (Bustaman, 2007). The village collecting traders and county collecting traders then sell their nutmeg products further to consumer or to exporting traders (Bustaman, 2007; Leunupun dan Turukai, 2019; Lawalata, 2019; Lating, 2021). Trading system which is not well organized usually resulted in uneven profit distribution which mainly unfair for the farmers since the difference between farmer's price and consumer or exporting trader's price (margin price) is usually very high.

During that time period, nutmeg development was isolated or separated among segmented roles or necessity of different parties or components/players involved in its value chain. Farmers cultivate, produce and prepare the products for marketing; collecting traders purchase the products without having to understand or interfere with the farmer's affairs; post-harvest business entrepreneurs implement post-harvest technology and adding values to products available, consumers utilize the product without any concern about recycling of by-products and so on. For example; during a telephone conversation, a collecting trader indicated that the mace she bought from a farmer was probably contaminated with aflatoxin, but further indicated that the quality of fully is the responsibility of farmers and not buyers or collecting traders.

In the periode of recent years, a number of small family business enterprises in Maluku province (Fig. 2) were established, which collect nutmeg products from farmers from different cultivation centers and further exporting the products overseas especially to Europe (Netherlands) and lately to China. The companies were PT. Ollo family business based in Hila Kaitetu Village Central Maluku Regency (nowadays PT. Ollo is no more in operation), Kamboti Pusaka Maluku Family Business, station in Laha Village, Ambon Municipality which further developed into Kamboty Spice Maluku stationed in Gudang Arang Ambon and Maenusu, station in Laha Ambon. These family businesses collaborate with European trading institutions especially of the Netherlands such as Tasane Maluku business community in the Netherlands, Verstagen family business, one of the biggest spice exporting company in the world today, as well as NGO's and experts, in matters related to consulting, training, research and development as well as export. In terms of working relationship with nutmeg farmers, there has been involvement of family business enterprises in efforts to improve the quality of planting system and the products specifically in Hilla-Kaitetu and surrounding villages. This situation was elaborated by Hatunia et al. (2016) in a model of patron and client, in which patron (PT Ollo) buy the nutmeg products from client (farmers) with a higher price than that of collecting traders of village, municipality of city collecting traders, providing training and seeds to the farmers, promoting organic certification, establishing farmer's cooperative as well as donating to community's social activities in the Hilla-Kaitetu and surrounding villages.



Figure 2. Up-grading of facilities to improve nutmeg products' qualities (a-c) and products preparation for export (d-e) at the family business enterprise in Maluku. Source: Mr. Frits Blessing, Maluku Living Laboratory NGO (c-e).

Trading flow of nutmeg products as mapped by Kamboty Pusaka Maluku Business Company is shown in Fig. 3. Kamboti Pusaka Maluku business company purchase nutmeg products from the farmers of Leihitu, West Leihitu, Salahutu, Ambon Bay, South Leitimur regions of Ambon Island and farmers of Ceram, Haruku (masohi, Piru and Bula), Saparua and Banda islands indirectly through village or county collecting traders. In addition to trading to kamboty Pusaka Maluku Company, the collecting traders also trade the nutmeg products to provincial collecting traders or to other cities and provinces such as Surabaya, Jakarta and Bitung with the use of sailing service of Indonesia National Sailing Company (PELNI) or other sailing services (Fig. 3). The marketing or purchasing price, as experienced by Kamboty Pusaka Maluku Business was unstable due to the absence of regulation on Maluku nutmeg's trading system.

With regards to export to the Netherlands (Rotterdam), nutmeg products are transported to Surabaya from Yos Sudarso ship port in Ambon, in order to carry out a number of analyses, receive fumigation and acquire of certain documents before further shipping to Singapore and continued to importing country (Netherlands) covering a period of 12 weeks. Stopping by in Surabaya or Jakarta, spending 3-4 weeks time period is needed due to the absence of infrastructures and supporting facilities legally acknowledge by the importing country such as laboratory for Aflatoxin analyses, fumigator and ship operators (Lating, 2021).

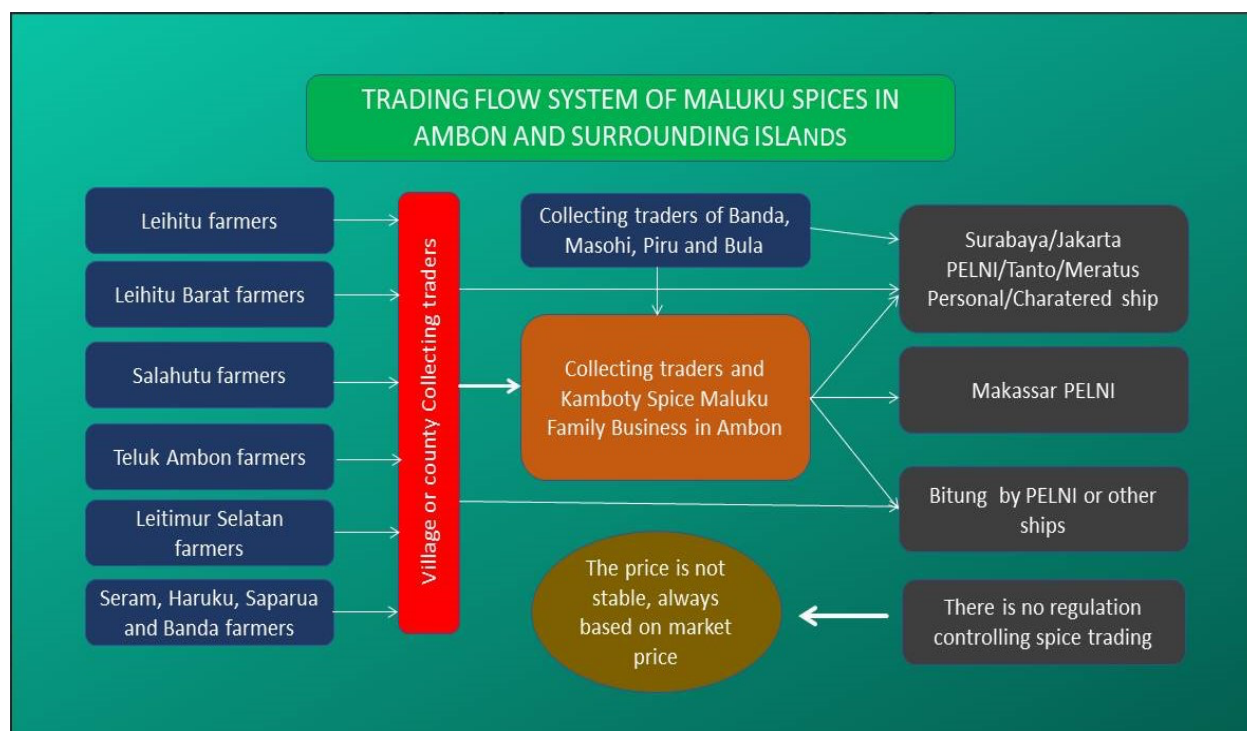


Figure 3. Trading flow chart in Ambon Island and surrounding areas of nutmeg (*Myristica fragrans* Houtt.) according to Kamboty Spice Maluku. Source: Re-draw after Lating (2021)

The Blended Learning-Value Chain (BLVC) Project

The concept of agricultural development in inclusive and sustainable manner was initiated at the Faculty of Agricultura Pattimura University through a joint project of Indonesia and Netherlands named “Setting Up a Blended Learning Program for Sustainable Inclusive Agricultural Value Chain Development in Indonesia” (Blended Learning-Value Chain). The project accomplished two main tasks; first establish and implement a blended learning program, which is a hybrid between konvensional, face to face learning system and internet learning system, and second develop and implement a teaching module of agricultural value chain analysis, a newly developed scientific branch of economic science, as the substance of the above blended learning program. Characters of the developed value chain course and research are inclusive and sustainable. Inclusive was implemented in terms of scientific specialty (inclusion of Agronomy, Post harvest technology and Agribusiness Department and study programs), in terms of business scale and operational region include in its implementation (inclusion of micro, small, medium and big businesses at local, regional, national and international levels) and organizational affiliation (government and non-government organizations). The sustainability character is implemented in three aspects; sustainable in terms of environment including biodiversity, sustainable in terms of people, community including the use of human and animal labours, and sustainable in terms of profit through the improvements in every single chain in the value chain of i. e. an Agricultural commodity (Leunufna et al., 2021 a, b).

Nutmeg was one of the five target commodities of the project in terms of teaching and researching and in its implementations; the project has supported student’s research in Banda and Ambon Islands on value chain of nutmeg commodity, encouraged researches on target

commodities at the Department of Agribusiness, Post-Harvest Technology, Agronomy and Plant Breeding, Faculty of Agriculture Pattimura University. Studies were also conducted by a number of scientists and practitioners at different institutions and were composed as a reference book for further teaching and learning on Agricultural Value Chain Analyses course. The research and scientific papers were presented in two seminars and one final webinar of the BLVC project (Leunufna et al., 2021 a, b Fig. 4).

The joint project BLVC was completed by a number of institutions at the local, national, and international levels with Agrofair Company, Netherlands as the general manager, faculty of Agriculture Pattimura University as the beneficiary, Maastricht School of Management the Netherlands and Bogor Agricultural University as counterparts, and the Netherlands Organization for Internationalisation of Education (NUFFIC) as the main source of funding. Later in the development, several other institutions take part in the value chain teaching and researching including Institution for Agricultural Technology Assessment (BPPT) Maluku, Kamboti Pusaka Maluku family business, Maluku Business Community Tasane, Netherlands, as guest lecturers, researchers and authors of agricultural value chain course reference book as well as keynote speakers in Seminars/Webinar conducted. Further more several other institutions were actively participated in providing inputs to the project and as keynote speakers in the project's seminars/webinar including Maluku Agricultural Department, Ambon Municipality Institution of regional planning and development, Nasional Institution for Palm Research, North Sulawesi and Verstagen family business company, Netherlands.

As a part of the project's program, delegates from the beneficiary institution take part in an experience visit to the Netherlands and Ecuador with the objectives of observing and acquiring knowledge and experience on Agricultural value chain practices of Cavendish banana as well as, having discussions and establishing contact with several international institutions such as Agrofair Company, Netherlands, Wageningen University and Research, Wageningen, Naturalis Biodiversity Institute, Leiden, Verstagen Family Business Company, and Banana Growers Association of El Guabo, Assogabo, Ecuador (Leunufna et al., 2021 a, b).



Figure 4. Various activities of BLVC project: Internet and face to face Lecturing (a-d), workshop (e), student's presentations (f-g), seminars with keynote speakers from different institutions (h-i) and evaluation meeting (k-l). Source: BLVC's project documents.

Nutmeg Innovation Platform Maluku

As a means of continuation of the BLVC project activities following its termination after 3-4 years of implementation, some of the project's achievements were institutionalized i.e. inclusion of agricultural value chain analyses course into curriculum of the Faculty of Agriculture Pattimura University and establishment of Nutmeg Innovation Platform Maluku. Innovation platform can be loosely defined as a platform or place where parties (people) with similar visions gather together to learn, to brain-storm, to provide and discuss inputs, ideas and problems, and to implement the ideas or to act on the solutions for the development of common objectives, which is, in this, case nutmeg commodity of Maluku province.

Nutmeg Innovation Platform Maluku (NIPM) was officially established through a memorandum of understanding (MoU) signed by Governor of the Maluku Province, Rector of the Pattimura University and Managing Director of the Agrofair Company the Netherlands (Fig. 5a). It is composed of a number of institutions related to the government, education and research, business, NGOs and farmers and farmers' group. Those which have been involved are Provincial Regional Planning and Development Institution (BAPEDA Maluku), micro, small, and medium enterprises institution (UMKM) Maluku, Maluku Department of Agriculture, Pattimura University (Faculty of Agriculture and Faculty of Mathematics and Natural Sciences), Institute for the Assessment of Agricultural Technology (BPTP) Maluku, Agricultural Vocational School Passo (SMK Passo), Ambon, State Vocational Schools no. 2 (SMKN 2), no. 4 (SMKN 4) and no. 9 (SMKN 9) Seram Island, Kamboty Spice Maluku Family business, Maenusu Family business,

Nutmeg farmers and Farmers' group, Liliboy, Agrofair Company Netherlands, MDF training and consultancy, Bali, Q-point, Maluku living Laboratoty and others.

Four working groups has been established in NIPM, each elaborates the topics of Standard Operational Procedure (SOP), Infra-structure, Seed and seedlings and Information and communication technology, to be further presented and discussed in the meetings of NIPM. Through joint works with other institutions, NIPM prepared proposals to fund implementation of some of its programs. Taylor Made Training proposal with the title "Capacity building in the field of post-harvest management and rural entrepreneurship to develop competitive, sustainable and gender sensitive value chain in Indonesia", was submitted to funding provider in September, 2021 with Q-Point B.V. the Netherlands as the main coordinating institution. The second proposal entitled "Conservation of tropical forests, biodiversity and endemic species in Maluku and the Wallacea – prosperity of small nutmeg farmers' households as driver" with Rikolto, an International Non-government Organisation, Indonesian branch office as the main partner, was submitted in January 2022. Both proposals received high value and appreciation but were not successful in being funded due to high competition. Further proposals are still being prepared by NIPM.

In further collaborations, members of NIPM took part in a graduate course of "global learning experience" at the department of business Information System for the Digital Era, the Institute Mines Telecom Business School Paris, in terms of being a guest lecturer on Nutmeg Innovation Platform Maluku as well as being judge panel members for the graduate students' presentations (Shiris, 2022 - Fig. 5 b,c). Several suggestions related to the use of recently developed information technologies in efforts to communicate informations among nutmeg's farmers in Maluku were made. As well, possibility to further collaborations in the future was proposed. As understood, small islands of Maluku are mostly isolated from each other due to the lack of transportation and internet connection (wifi signal).

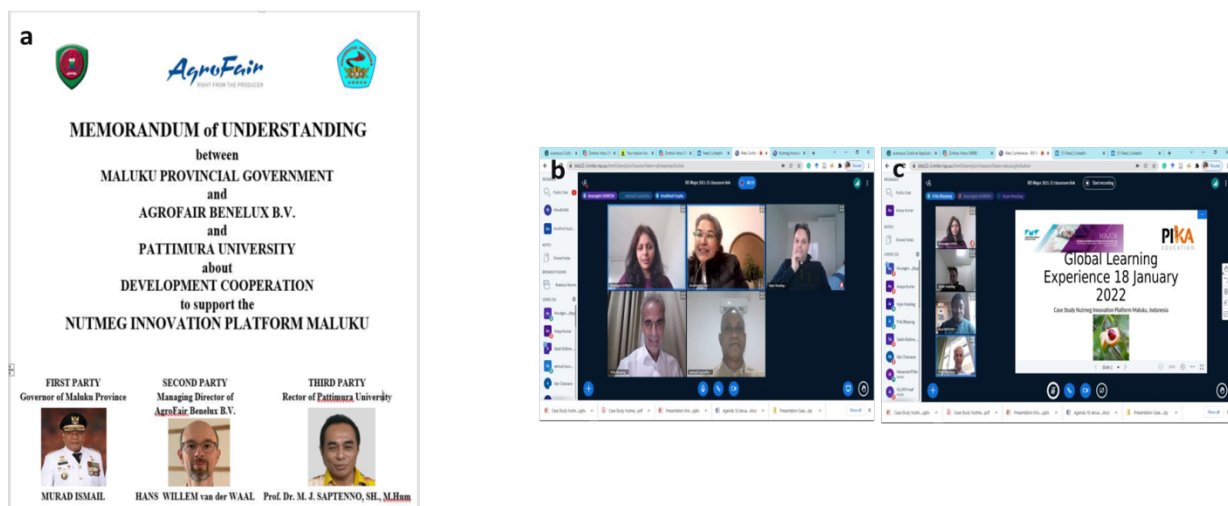


Figure 5. Memorandum of Understanding (MoU) for the establishment of Nutmeg Innovation Platform Maluku (a), Lecturing, presentation and discussions of graduate students of the Institute Mines Telecom Business School Paris (b dan c). Source: Document of NIPM (a) and Shiris (2022 b, c)

Opportunities and Challenges on Maluku Nutmeg Development

In further development, different factors promoting or impeding the development of nutmeg commodity need to be identified and dealt with. A number of opportunities, challenges as well as problems identified are discussed randomly as follows;

Plant age and land ownership; Banda case

It is depicted in Table 1. above that, eventhough, Central Maluku Regency, where Banda Island situated, has the highest total Nutmeg production, the production per ha is lower than that of Ambon and Tual Municipalities. Among the possible reasons indicated previously, observation in Banda Island showed that the problems of land ownersip in relation to the age of nutmeg trees (which are nowadays quite old), which coorelated to decreasing of nutmeg yield is another cause of reduction in tree production (kg) per planting area (ha) in Banda Island and at the end contributes to the reduction of total production per hectare of Central Maluku Regency. Studies (Simanjorang et al., 2020) comparing competitive advatages of nutmeg farming between Banda region and Ambon region showed that nutmeg farming in Banda region is more competitive than that in Ambon region. However, the data also indicated that average seed productivity in banda region (0,23 kg/ha) is slightly lower than that in Ambon region (0,24 kg/ha).

Depends on the species and/or cultivars, nutmeg tree inisiate flowers 5 years (in Grenada, Singh et al., 2003) or 7 to 8 years (cases in Maluku) after planting. Following first flowering or fruiting, tree production will continuously increase up to 20 – 25 years. Production is constantly high during the age of 25 to 50 years and decrease up to 80 years (Flach, 1966; Bustaman, 2007). Nutmeg trees in Banda region are mostly in the condition of old age and need to be rejuvenated. However, the farmers hesitate to replant the trees, eventhough the seeds have been prepared by the government, because the land ownership is not of the farmers but the government; farmers refuse to be only the cultivators (workers) (Lawalatta et al., 2017; Clercks and Leunufna, 2018).

Data in Table 3, with small calculatios, show that each nutmeg farmer in Central Maluku Regency in the year 2017 cultivated a land area of 0.77 ha or with the use of 10 x 10 planting distance and 1 male to 10 female planting sex ratio (1:10), cultivated 70 trees potentially producing fruits. Bustaman (2007) indicated that when further assess, every farmer in Maluku poses only 0.3 ha of land with 37 productive trees. Aside of the farmers plantations, Maluku nutmeg is also manage by 5 big private estates as large as 10. 128 ha producing 2357 tons. Banda nutmegs composed of farmers' plantations and local government plantations following the nationalization of nutmeg estates after Dutch colonial era. The colonial nutmeg estates are now cultivated by famers with 70 to 30 percents of benefit partition between government and the farmer. Finding the solution for land ownership, through government isntitutions, will promote nutmegs production and farmers income and prosperity in Banda region.

Genetic Diversity, Certificate of origination, market niche and the proof of origination

According to Flach (1966) there exist only two center of cultivation in the world, the first and the oldest is at the area of origination of *Myristica fragrans* Houtt. Maluku, Eastern Indonesia with Banda as the main center, the second is Grenada West Indies. As the center of its origination, in Maluku distributed various species and varieties of nutmeg. Warbug (1892) described a number of nutmegs species important for human needs including *Myristica*

argentea Warb. distributed between Papua and Maluku, *Myristica fragrans* Houtt. (true nutmeg (*Die echte Muskatnuss*) distributed from Banda, Maluku to Minahasa, Sulawesi, Sanger; a number of varieties were described by Rumphius including pala Boy (Boy nutmeg), pala Bakambar (twin nutmeg), pala Pancuri (thief nutmeg/Diebsnuesse), pala Raja (king nutmeg), pala Putih (white nutmeg), and pala Domine (Domine nutmeg/predigermuskat); selanjutnya species *Myristica speciosa* (bacan Art) cultivated in Bacan, Ternate, *Myristica succedanea* spread within Tidore, Ternate, Halmahera, and *Myristica sheffei* (pala Onem) developed in New guinea as well as Ternate.

Based on the facts of its center of origin and its significant role in history as well as its specific geographical area and growing condition (warm climate, volcanic soil – Flach, 1966) etc. which implicate the uniqueness and the quality of its products, the government of Indonesia through the Ministry of Law and Human Rights granted the certificate of Center of origination with geographical indication (Rongiyati, 2018) to Banda Nutmeg (*Myristica fragrans* Houtt.). Such a certificate surely is not only recognition to the origin and uniqueness of banda Nutmeg, but also protection to its market niche especially the international market. With the increasing consumers' awareness of the pureness and quality of products especially in the international market, Banda nutmeg surely will have a special market niche internationally. Through a conversation with one of the biggest world nutmeg importer, it is understood that nutmeg products from different regions often claimed to be of Banda nutmeg, which then taking over market niche which is supposed to be of the original Banda nutmeg. In this context, through a joint work with nutmeg Innovation Platform Maluku, scientists at Naturalis Biodiversity Institute Leiden Netherlands has produced the DNA profile of Banda nutmeg and will be the reference to compare with other nutmeg products claimed to be of Banda nutmeg, and therefore become a way of protection to market niche of Banda nutmeg internationally.

Genetic mixture and quality of export products

It is elaborated previously a number of economically significant species and varieties distributed within Maluku islands, each with its specific characteristics, with Banda nutmeg (*Myristica fragrans* Houtt.) and papua nutmeg (*M. argentea* Warb.) received main emphasis on the quality by Warburg (1892). Studies have indicated that there are differences in certain quality components even within different ecotypes of species *Myristica fragrans* Houtt. In Maluku islands (Marzuki et al., 2014 – Table 3). However, in marketing management, all products from Maluku islands (province), are indicated as Maluku products without any distinctions among species or genetic back grounds and growing areas. This mixture will certainly reduce the average quality of Maluku nutmeg and therefore, there is a need to apply sortation within the Maluku nutmeg product to obtain the best quality especially for international market.

Table 3. Quality components according to Indonesian National Standard (SNI) of *Myristica fragrans* Houtt. from three different ecotypes in Maluku.

Quality component	Ecotype		
	Banda	Ambon	Luhu
Specific gravity	0,906	0,897 ^{ns}	0,909 ^{ns}
Refraction index	1,490	1,491 ^{ns}	1,489 ^{ns}
Optical rotation	+ 16,3	+ 13,0*	11,4*
Essential oil's content in the seed (%)	11,69 ^{ns} (young seed)	11,92 ^{ns} (young seed)	9,99* (young seed)
	13,07 ^{ns} (old seed)	12,82 ^{ns} (old seed)	11,27* (old seed)
Main Essential oil content:			
Myristicin	13,76	13,54	5,57
Elemicin	0,94	0,67	2,05
Safrole	2,44	2,46	0,97
(Iso) eugenol	0,90	0,55	0,70

Source: Re-arranged after Marzuki et al. (2014). Note. *) significantly different based on dunnet test, ^{ns} = not significantly different.

Propagation, seed nursery and productivity

Nutmeg cultivation was initiated about after the Second World War by way of occasionally transplanting the volunteers (Flach, 1966). Today, nutmeg cultivation should be seen in two important aspects; first to maintain and increase genetic diversity to be able to improve the possibility of sustainably developing new genotypes with desirable characteristics in the future and second to increase nutmeg production in the short and medium terms to be able to meet the increasing market demands. To answer the first aspect, nutmeg propagation need to be conducted as a way of sexual propagation allowing the possibility of independent assortment and segregation of chromosomes with genes in their locuses and possibility of new genes recombinations producing new genotypes of nutmegs, as that explained in Mendelian genetics, widen the genetic diversity and enable stability of nutmeg species evolutionary and ability to developed new improved varieties indicated previously.

Generally, nutmeg is a dioecious plant meaning that the male and female sex organs are separated in two different individual trees. In more detail, Denium (1932; 1949 in Flach, 1966) observed that seed propagation of nutmeg, with little variation, results in 55% female, 40% male and 5% bisexual. With the above sex-ratio, generative propagation of nutmeg will not benefits the farmers since almost half of the population (40%) in the planting area will not produce fruits. Studies have shown, however, that one male to 10 female planting ratio (1:10 ratio) is ideal enough for a good pollination and production (Flach 1966; Kayhatu et al., 2021). Sex determination in nutmeg should, therefore, be determined at the early stage of development (seed or seedlings stages) to be able to determine the field sex-ratio and the planting arrangement and not to wait 7 to 8 years for the first flowering stage.

Indigenous wisdom in determining nutmeg sex at early stages of development exist, including observation on seeds, as well as leaves, branches and roots characters at the seedlings stage. However, scientific studies confirming the practices are rarely found. Somehow, nutmeg cultivation in 1:10 sex-ratio still produce filials which are close relative to each other (as a

reference for 1:10 planting ratio, fruits of one tree are full-siblings to one another while those from other trees in the same population are half-siblings) meaning it is not fully answer the question of genetic diversity in nutmeg.

To respond to the short term yield increase in nutmeg, several methods of vegetative propagation have been implemented. The method of epicotyl grafting has been successfully developed and recommended to the farmers at production centers in Indonesia including Maluku province. Epicotyl grafting enables a combination of characters through selected scion and roostock to increase production and ensure the sex of seedling's prior to field transplantation.

Seedlings production by the use of staking method has also been implemented by Maluku Department of Agriculture mostly through collaboration with small scale seed growers. Selection of highly productive mother plant and abundant flower production of male plant will ensure a successful pollination and fertilization for maximum productivity of nutmeg trees, in addition to the assurance of sex ratio.

Application of biotechnology i.e. tissue culture techniques will support nutmeg seed provision with selective (high productivity etc.) genotypes and healthy seed through the use of meristem culture techniques for virus and diseases elimination, especially contamination by *Aspergillus flavus* and *A. parasiticus*. A study in Sri Lanka reported that shoot explant of 3 years old nutmeg tree can produce up to 4-5 shoots on the Anderson Medium supplemented with 2,0 mg/l BA with or without 0,1 mg/l NAA in a period of 8 weeks (Yapabandara, 1989).

Having recognized the advantages they possess, vegetative modes of propagation often take longer time to be ready and less in number or in other words relatively not very quick in filling the need for seedlings in comparison to that of seeds sowing. Indeed, the increase in production through vegetative/clonal propagation occurs with the sacrifice of genetic diversity, causing vulnerability to changing environments, in the long run, including pests and diseases infestation.

Standard Operational Procedure (SOP) and its implementation

Government programs in nutmeg developments through provision of standard procedure for various activities including seeds nursery, post harvest handling and business have been published, i.e. together with the technical instructions, and laws and regulations. For example the Decision Letter of Minister of Agriculture Republic of Indonesia number 320/Kpts/KB.020/10/2015 Regarding Guidance to Produce, Certify, Distribute, and Supervise Nutmeg (*Myristica fragrans* Houtt.) Seeds, regulate various aspects related to the seedlings in Indonesia.

Implementing the programs in Maluku province require preparation and building of the capacity of extension service personals by the Department of Agriculture at Provincial, Municipality and Regency levels with the support of other institutions including Education and Research institutions, Non-governmental institutions and others. Further extension services together with field demonstrations and provision of inputs and supporting factors will surely increase plant productivity and total nutmeg production in Maluku. The efforts in supporting

capacity building of nutmeg's stakeholders in Maluku is also carried out by Nutmeg Innovation Platform Maluku by submitting technical proposal to international funding providers.

Cultivation system, sustainability and market niche

Nutmeg cultivation in Maluku is accomplished in two different planting systems; monoculture and polyculture or multiple cropping. Monoculture system is found in areas such as Banda and Gorom islands (Kayhatu et al., 2021), and considered a system inherited from the colonial era. Cultivation system in most regions in Maluku (Banda, Ambon, Seram islands) is accomplished in agroforestry system called Dusun, a polyculture system which have traditionally been practiced by farmers in Maluku for centuries from generation to generation. Wattimena (2011) indicated that nutmeg cultivation by farmers in Banda island can be grouped into Dusun in its very simple form, in which only two plant strata exist i.e. canarium (*Cannarium commune*) at the high strata and nutmeg at the second strata. It may also be combined with clove (*Zyzygium aromaticum*) and melinjo (*Gnetum gnemon*).

Dusun type practiced in Seram and Ambon islands are of mixture type, cultivated with various different crops dominated by coconut, clove and nutmeg or dominated by fruit trees such as durian (*Durio zibetinus* Merr), gandaria (*Bouea macrophylla*), duku (*Lansium domesticum* Correa), langsung (*Lansium domesticum* Correa), kokosan (*Lansium domesticum* Correa), bacang (*Mangifera foetida* Lour), kuini (*Mangifera odorata* Griff), manga (*Mangifera indica* L.), rambutan (*Nephelium lappaceum* L.), bali snake fruit (*Salacca zallaca* var. *amboniensis* Becc). Other crops in mix dusun are leleba (*Bambusa atra* Lindl), yellow bamboo (*Bambusa vulgaris* Scharad), patong bamboo (*Dendrocalamus asper* Backer), lenggua (*Instia ambonienseis* Thouars), gamutu (*Arenga pinnata* Mur), Kemiri (*Aleurites* spp.), areca nut (*Areca catechu*), melinjo (*Gnetum gnemon*), petai (*Parkia speciosa* Hassk), and others (Wattimena, 2011).

In a mix cropping type (dusun), there are generally 4 strata; strata -1 (the highest strata) is covered with canarium, petai, salawaku and others; strata 2 is filled with fruit trees; areca nut, enau and others; strata-3 filled with snake fruit, pineapple, banana; and strata-4 (the lowest) filled with deris (*Deris elliptica*), tuber crops (*Dioscorea*, *Xanthosoma* spp., *Colocasia* spp. and pineapple).

A number of dusun crops such as canarium, coconut and others are function as keystone species i. e. as food providers for other component of biodiversity such as various birds, kus-kus and others, and enrich the biodiversity in dusun system. Wattimena (2011) explain the connection between dusun system developed in Maluku islands with sustainability defined by Gibbs (1987); first it is ecologically sound means the quality of natural resources are integrally preserved from animals, plants and microorganisms, second economically viable means that the farmers can acquire all their needs out of dusun, and third, socially just and humane, means that dusun is also benefit those who are poor in the community and the dignity of all living is taken into account i.e. through *Usu* local wisdom where part of the harvest which fall down from the tree belongs to the poor and *Sasi* local wisdom where harvest should not prevent the capability of reproduction.

In the paper "strategy of maintaining Indonesia as the main nutmeg producer in the world", Hafif (2021) emphasis the need to promote good agricultural practice (GAP) base nutmeg

farming technology such as mix garden and agroforestry. With the increase in the need for sustainable environment and biodiversity, farming system implementing GAP will have greater markets due to high consumer preferences, especially in developed countries such as Europe, USA etc.

Money lender practices and solution proposals

In certain cases, lack of market information, lack of supporting infra-structure, sudden and desperate needs of family for different necessities such as sickness or wedding of family members, school or religious necessities, as well as erroneous climatic conditions (i.e. *May Dew* in which rough weather causing nutmeg fruits to fall, Lawalatta, 2017), often conditioned farmers to market their nutmeg plants (with fruits) before or after harvest to money lenders with a price far lower than market price. Money lending transactions which are simple, not complicated, anywhere, anytime, as long as both parties understand each other, offer an attractive appeal for money lending practices. Studies of money lending practices on clove's farming (Pangemanan *et al.*, 2018) indicated that the highest percentage of money lending practices occur among siblings or family relatives followed by business partners, and other parties. More than 70% of farmers involved in money lending practices expressed to be benefited from the practice while 23% expressed to be detrimented. The study concluded that the money lending practices persist because most of the farmers feel helped. Although it is fast, easy and beneficial at the time, money lending trap will cause farmers not easy to break out from the poor economic situation and therefore has to be prevented.

In the discussion related to money lending practices on nutmeg farming in Maluku during the meeting of Nutmeg Innovation Platform Maluku, it was proposed that the government through Micro, Small, Medium Enterprises (UMKM) Department of governor's office may facilitate farmers with soft credit from the bank to be able to deal with sudden urgent need of the farmers. The use of *storage receipt* (resi gudang) system is also considered helpful in this case, where farmers can store their nutmeg products in the government storage facilities and receive the receipt as a proof of their belongings. Using the receipt as collateral, farmers can obtain loan from the bank or related institutions to support their need and market their nutmeg products only when the purchasing price is satisfactory. The storage receipt system is regulated in Indonesia through Act No 9 year 2006 regarding Storage Receipt System (Sistem Resi Gudang - SRG), which was amended with Act No 9 year 2011 (Ashari, 2011).

Profit margin, pricing policy and economic appeal of nutmeg farming

Studies in Banda and Ambon regions indicated that generally, nutmeg tradings are taking place in two different value chains; long chain i.e. from farmers to village collecting traders (VCT), county collecting traders (CCT) and ended with exporting traders (E), and short chain i.e. from farmers to county collecting traders and ended with export collecting traders (Leunupun and Turukay, 2018; Lawalatta, 2019). Out of the 130,000 IDR/kg market price of nutmeg at the exporting traders, farmers shared 53.84% or 70,000 IDR/kg in the long chain (Table 4) and 57.69% or 75,000 IDR/kg in the short chain (Table 5). With a small additional investment, village collecting traders shared a margin profit of 4,865 IDR/kg or 3.2% (Table 4). Similarly, with some additional expenses, county collecting traders shared a margin profit of 49,07 IDR/kg or 37.74% both in the long chain and short chain (Table 4 and 5). With the analysis of the above profit margin of nutmeg seed marketing, it is shown that farmers have the possibility

of increasing their profit out of their nutmeg cultivation with some additional investments and knowledge of market information, something which can be achieved through bank loan or other policies and participation in farmers association or farmers group or other government interventions.

How much is the price of nutmeg products (seed, mace, powder) should be received by farmers to be fair with the investments given to their nutmeg farming system? How is the mechanism of determining nutmeg bottom price? Who are the parties making the bottom price decision? How far are the farmers or farmers associations' involvement in determining the price of nutmeg products? are some questions worth asking. If the nutmeg products are traded internationally with high prices, then the farmers should have a right to earn more from their labours. According to the head of Agriculture Department of North Maluku Province, nutmeg price has always been determined by money lenders causing farmers to hardly enjoy better income from their nutmeg products (Aminuddin and Nikita, 2018). He urged Agriculture Department of regencies within his authority (North Maluku Province) to take control of nutmeg market price. Lack of economic attractiveness of nutmeg farming may hinder the sustainability of nutmeg role as a superior commodity in Maluku due to decreasing interest in nutmeg farming and business by young generations.

Table 4: Analysis of marketing margin of nutmeg seed in Banda county with Long Market Channel (Farmer, VCT – CCT-Exporter)

No.	Item	Cost (IDR/Kg)	Cost (IDR/kg)	Share (%)
1	Farmer			
	Purchasing price to VCT		70,000	53.84
	Transport cost	64.1		0.01
	Packaging cost	104		0.08
2	Village Collecting Traders (VCT)			
	Purchasing price from farmers		70,000	53.84
	Packaging cost	30.01		0.68
	Transport cost to CCT	36.7		0.08
	Labour cost	68.11		41.53
	Marketing cost	134.8		0.63
	Profit margin	4,865		3.2
	Total margin	5,000		3.85
	Purchasing price to CCT		75,000	5.69
3	County Collecting Traders (CCT)			
	Purchasing price from VCT		75,000	57.69
	Packaging price	220		0.16
	Transportation cost to harbour	230		0.17
	Labour cost	10		7.69
	Expedition fee	133		0.1
	Marketing cost	5,930		4.56
	Profit margin	49,070		37.74
	Total margin	55,000		42.3
	Purchasing price to exporter		130,000	100
4	Eksporter			
	Purchasing price from CCT		130,000	100
	Sum: Total Marketing Price : IDR	6,065		
	Profit Margin	: IDR 53,935		
	Total Margin	: IDR 60,000		

Source: Lawalatta (2019)

Table 5: Analysis of marketing margin of nutmeg seed in Banda county with Short Market Channel (Farmer- CCT-Exporter)

No.	Item	Price	Price	Share (%)
1	Farmers			
	Purchasing price to CCT		75,000	57.69
	Packaging cost	58,57		0.04
	Transportation cost to CCT	146		0.11
2	County Collecting Traders (CCT)			
	Purchasing price from CCT		75,000	57.69
	Packaging cost	220		0.16
	Transportation cost to harbour	230		0.17
	Labour cost	10		7.69
	Expedition fee	133		0.1
	Marketing cost	5,930		4.56
	Profit margin	49,070		37.74
	Total margin	55,000		42.3
	Purchasing price to Exporter		130,000	100
3	Eksporter			
	Purchasing price from CCT		130,000	100
	Sum : Total Marketing price: IDR 5,93			
	Profit Margin : IDR 49,070			
	Total Margin : IDR 55,000			

Source: Lawalatta (2019)

Battling aflatoxin contamination

Aflatoxin is the number one enemy of Indonesian's export of nutmeg including Maluku and, therefore, efforts to improve nutmeg's product qualities should be directed to overcome the aflatoxin poison and its sources in nutmeg, which are fungi of the genus *Aspergillus*. *Aspergillus* is a storage room fungus which infected seeds in storage and dormant in cold and dry condition, however can infect seedling or plants later on in the growing periode depending on ideal environmental condition, stage of plant development, level of plant resistance and interaction among the factors mentioned above (Justice dan Bass, 2002; Rahayu, 1999; Yuniarti et al., 2013; Schmidt, 2000).

Battling the aflatoxin in nutmeg, therefore, require integrated efforts both on plants and on products. It requires the use of resistant varieties, healthy seeds and seedlings, good cultivation methods and techniques, suitable post harvest handling including methods and techniques of drying, packaging, storing and transporting with care on the environmental condition (temperature and humidity).

Although, not frequently reported as pathogen causing diseases in plant during the growing and development periods, wide spread contamination of *Aspergillus* causing aflatoxing intoxication occurs right before harvest on seeds of several commodities such as nutmeg, soybean, ground nut, corn, coffee and pepper. Aflatoxin B1, B2, G1, G2 are micotoxin naturally occurs, highly toxic and carcinogenic (Susilowati et al., 2020).

Several newly developed superior varieties of nutmeg with high production and short flowering and harvesting periods have been recommended by the governments e.i. Ternate-1

nutmeg from Ternate (https://www.benihperkebunanols.com/index.php?route=product/product&product_id=84), Tidore-1 nutmeg from Tidore (teknologi-indonesia.com/pertanian-dan-pangan/inovasi-pertanian/pala-varietas-tidore-1/) and Fakfak nutmeg from Papua (<https://www.litbang.pertanian.go.id/info-teknologi/3077/>), and others. It is also important to mention that superior varieties developed in monoculture system may perform differently when grown in dusun system and, therefore, should be taken into consideration.

The use of tissue culture to produce healthy (free of pest and diseases) seeds have also been suggested to go about aflatoxin contamination. As well, appropriate cultural methods and techniques may ensure the resistency of the plants to pest and diseases and to reach an optimum production according to its genetic potential.

Pre-harvest and post-harvest management of nutmeg products plays important role in determining nutmeg products quality; many of the practices have been confirmed by research findings and recommended by the government. The practices include maturity stage of nutmeg fruits, harvesting the fruits on the tree not on the ground, product's sun drying or smoke drying in appropriate manner (drying off the ground and not on the ground; not directly contact with the sun etc.), maintaining suitable temperature and humidity during storage and transport (Supriadi 2017; Siwalette et al., 2018; Susilowati et al., 2020).

In the field visits in Ambon as well as discussions during the meeting of Nutmeg Platform Maluku, it is found that, even though, some farmers have been practicing the right methods and technical procedures of nutmeg post-harvest handling, many others are still fail in conducting similar practices (Fig. 6).

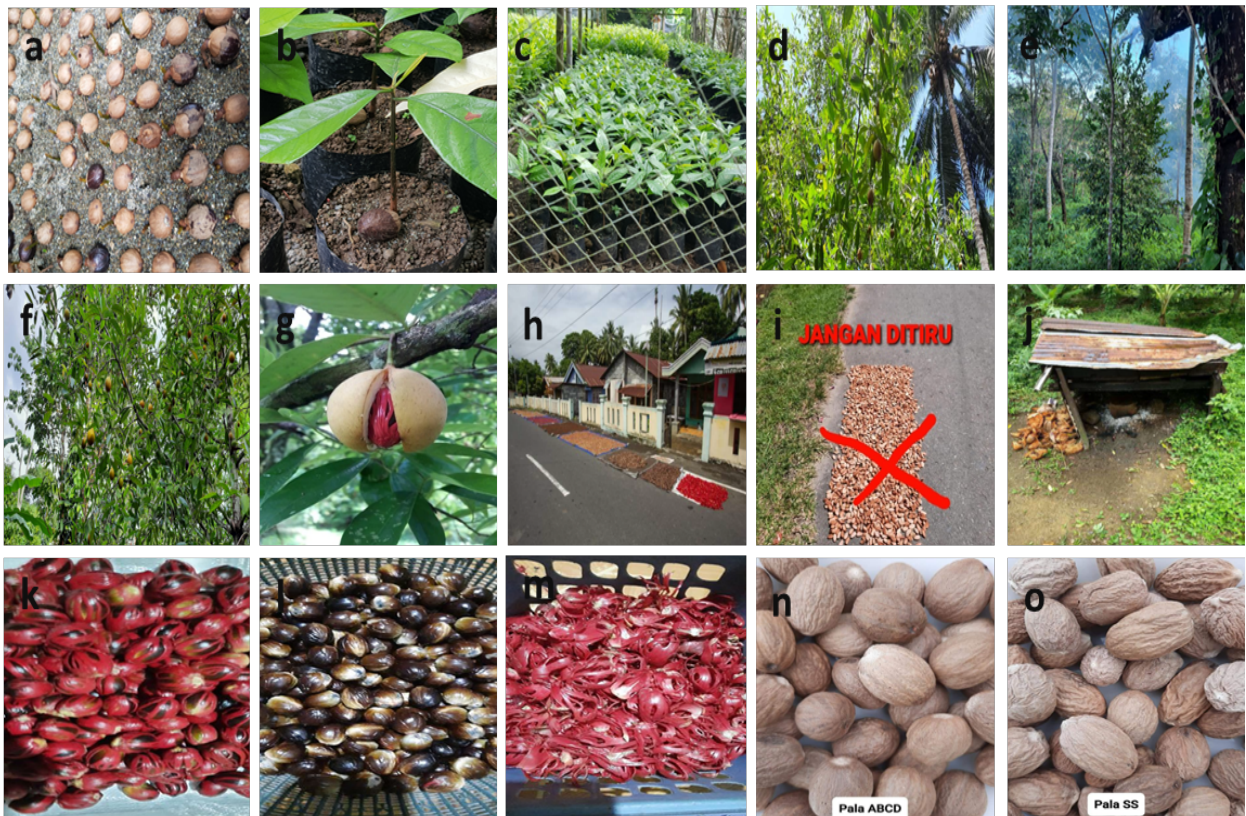


Figure 6. Nutmeg seed sowing nurseries in Liliboy Village, Ambon Island (a-c), Nutmeg cultivation in dusun system at Hila Kaitetu Village, Central Maluku Regency (d-f), maturity stage of nutmeg fruit, ready for harvest (g), several techniques of drying nutmeg's seeds and mace by velagers in nutmeg production centers in Ambon Island; those which are prone to aflatoxin contamination (h-j), and some of the highest quality nutmeg products of Ambon Island (k-o). Source: Author's field documentation (a-c). Lating J., Kamboty Spice Maluku (Downloaded with permission, d-o).

Quality standard, certification and marketing

To be able to compete in domestic and global markets, nutmeg products require to possess quality and proof of the quality through certification documents. Standardisation is an effort to maintain product's quality and business efficiency while certification is the activities of judging the trueness of the quality which related to producing a written document indicating that the products adhere to regulations (Dararizki et al., 2020). Standardisation and certification are benefiting nutmeg products' marketing by providing guarantee to the consumers that the product's quality is true to what is promised and, therefore increase consumers' trust, protecting the consumers from low quality products, and securing international approval and can therefore be traded across countries (Dararizki et al., 2020).

Indonesian nutmeg's quality standard is described in SNI 006:2015 produced by Indonesian National Certification Institute (BSN). In this document, nutmeg quality class and parameters are determined for nutmeg seed with shell, nutmeg seed without shell and mace in addition to methods and procedure of measuring the parameters (https://www.academia.edu/32132675/SNI_0006_2015_pala). Nutmeg international Standard is determined by International Organisation for Standardisation (ISO) which is a

federation of National Standardization Institutes of member countries. International Standards for nutmeg (specific for *Myristica fragrans* Houtt. and not for *M. argentea* Warb.) is regulated in ISO 6577:2002(en) Nutmeg, whole or broken, and mace, whole or in pieces (*Myristica fragrans* Houtt.) — Specification (<https://www.iso.org/obp/ui/#iso:std:iso:6577:en>). In general, standards parameters released by ISO is adopted by SNI Indonesia and other ISO members since it is common agreement. Other standard institutions such as European Union, however, applied a more rigid standard.

In terms of obligation to adhere to the standards by nutmeg products, SNI and ISO, as well as GAP (for examples) fall into general category or not obligated, different than that of Halal, maximum limit of pesticides residue and contamination (for example) which are obligatory. However, they are clearly determinant factors in market competitiveness domestic and global; an example is the rejection of nutmeg export products due to Aflatoxin contamination indicated previously. Other standardization and certification such as organic and fair trade, specifically as by certain market segments, are tertiary in category.

Compliance to the standardization and certification by Maluku nutmeg products have been developed and continuously improved. Export to Europe has been done both by PT Ollopo Hilla Kaitetu as well as Kamboty Spice Maluku, Gudang Arang (Lating, 2019), even though become stagnant due to Aflatoxin problems. Export to China is being done through Yos Sudarso ship harbor by PT Maenusu, Laha, in which the standards applied is not as strict as that applied by European market. Organic certification has been practiced by PT Ollopo (Hatunia et al., 2016) and continued by PT Kamboty Spice Maluku. Other certification such as fair trade may enable more benefits to nutmeg's farmers. For example, fair trade certification on Cavendish banana in Ecuador benefits farmer's association about one million US\$ every year (Leunufna et al., 2021 a, b).

Infra-struktur

Nutmeg products to be exported by small family business such as Maenusu and Kamboty Spice Maluku are obtained from different production centers distributed among and within islands of Banda, Ambon, Seram and others even from other provinces. Several obstacles restricted the collection activities affecting product's quality, business appointment schedule and therefore the business profit. Absent of road infra-structure, damage of roads, unavailability of transportation, lack of sanitation system at harbours, unavailability of shelter at harbours, uncertain ship schedule, damage and/or leaking ship, uncertain waiting period at harbor, long period of official documents preparation are among some which can be mentioned. Often time the shipment from other provinces arrived on schedule in comparison to that within the province.

In the discussions related to infra-structure by nutmeg by Nutmeg Innovation Platform Maluku, it is decided to conduct a study on supply chain (value chain) of nutmeg with emphasis on availability and condition of infra-structures both at the provincial and regency/municipality levels. Initial step of this study has been carried out by the research team of Maenusu and Kamboty Spice Maluku by inventory locations of farmers and collecting traders.

Based on results of the research and identification of infrastructure problems encountered, Maluku Government, i.e. Maluku Institute for Regional Planning and Development (BAPEDA) will perform coordinations with related institutions at the provincial and regencies/municipality levels to provide solutions. More over, as indicated previously, availability of accredited laboratory for aflatoxin analysis and other sanitary treatments in Maluku, necessitate nutmeg products to be evaluated in Surabaya or Jakarta, a procedure which is costly in time and money. Maluku nutmeg development will be more elevated with the availability of such infra-structure and various related regulations by the Maluku Government.

CLOSING/ CONCLUSION

Future development of Nutmeg commodity, in efforts to promote a community, especially nutmeg farmers and small business community which are prosperous and sustainable, requires a close collaboration among stake-holders i.e. government, education and research, business institutions, community and press (which communicating development information). The collaboration in the form of quintuple-helix takes place at every single chain of the value chain or supply chain of nutmeg commodity. The collaboration is inclusive in many aspects i.e. scientific specialty (agronomy, plant breeding, post-harvest technology, and agribusiness), business scale (micro, small, medium, big enterprises), operational geography (local, national, regional, international) as well as institutional affiliation (Government, non- government).

More over, the intended sustainable living concerns not only economic aspect by gaining continuous profits, but also development and improvement of human dignity as well as the safety of environment and biodiversity.

Maluku nutmeg development is faced with opportunities, challenges and problems which are to be understood and to deal with, some of those related to many aspects which have been discussed in this paper i.e. history and origination, land ownership and capital, genetics and agronomy (seeds and seedling nurseries, planting system, pest and diseases management, harvesting), post-harvest management (efforts to meet market quality standards; local and exports), marketing (marketing system, bottom price and marginal profits, marketing infrastructure), training and capacity building of farmers and extension services personals, government regulations, and others.

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