

Nov. 23/24, 2018

International 서울국제술학술대회 SOOL CONFERENCE Seoul 2018

도작(稻作)문화와 쌀술산업 - 21세기 새로운 좌표 설정과 재창조를 위하여
Rice Farming Culture and Alcoholic Rice Beverage Industry
- a New Framework and Plans for the Future

장소: 서울대학교 농업생명과학대학 201동 환경관 1층 대회의장
Grand Conference Hall, 1F., Center for Environmental Management (201),
College of Agriculture and Life Sciences, Seoul National University

기조연사 Key note speaker

김태영 Tae Young Kim
농촌진흥청 Rural Development Administration

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Special Preconference Lecture: Oct. 31, 2018

박선욱 Sunoak Park
캘리포니아주립대학교, 롱비치 CSULB

SESSION 1

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RICE FARMING AND ALCOHOLIC
RICE BEVERAGE: FROM ANCIENT DAYS TO NOW

S1-1: 동아시아 도작문화와 전통발효식품 속 술
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in the Rice Farming Culture of East Asia
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한국학중앙연구원 The Academy of Korean Studies

S1-2: 인류 최초의 생물공학, 고대 양조기술의 문명사적 재조명
Uncorking the Past: Alcoholic Fermentation as
Humankind's First Biotechnology
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펜실베이니아대학교 University of Pennsylvania

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Modern Korea: a Technology Historian's View
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전북대학교 Chonbuk National University

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슈잉핑 류 Shuangping Liu
장강대학교 Jiangnan University

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우다이네대학교 Udayana University

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and the Perspective on its Future Development
고 청창 Wen-Ching Ko
다웨이대학교 Da-Yei University

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호치민시기술대학교 Hochiminh City University of Technology

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서울벤처대학원대학교 Seoul Venture University



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Comparison of Brewing Method of the Major Alcoholic
Beverages in the World
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경기도농업기술원
Gyeonggi-do Agricultural Research and Extension Services

S3-2: 유럽연합 와인 클러스트의 산업화 사례 및
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and Economic Value of A, O, C.
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It's meaning and outlook
박선욱 Sunoak Park
캘리포니아주립대학교, 롱비치
California State University, Long Beach

> Nov. 22, 2018: Welcome Reception
> Nov. 25, 2018: Industry Excursion



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Young-Ha JOO, Rep. of Korea

Joo, Young-ha (Chu, Yo'ng-ha) 주영하 (周永河) Professor Faculty in Cultures and Arts, Graduate School of Korean Studies, The Academy of Korean Studies Education - B.A. Department of History, College of Humanities, Sogang University, South Korea - ...

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Patrick Edward McGovern, USA

Patrick E. McGovern is the Scientific Director of the Biomolecular Archaeology Project for Cuisine, Fermented Beverages, and Health at the University of Pennsylvania Museum in Philadelphia, where he is also an Adjunct Professor of Anthropology. He has an academic background combined the physical sciences, a...

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Postscript



Sunook Park, USA

Sunook Park Professor School of Arts, California State University, Long Beach Current Positions - Full Professor / Graphic Design Program, School of Arts, California State University, Long Beach, CA - Creative Director / Brand Workshop, CSULB - Brand and Marketing Consultant / sunookpark.com, Lo...

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Henri de Dampierre, FRANCE

Henri de Dampierre Wine and Spirits Producer (Wines, Pineau des Charentes and Cognac) in The Chateau de Plassac, Plassac - "The beautiful Chateau de Plassac is the jewel of the Cognac region. Its architect, Victor Louis, who also designed the plans for the Palais Royal in P...

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Yves Panneels, Belgium

Yves Panneels - Chairman of The Gueuze Society Consumers Association (Since 2010) - Board Member of the High Council for Artisanal Lambic Beers (HORAL), the Gueuze Producers Association of the Payottenland and the Senne Valley (Since 2006) - Board Member of Landbouwkrediet - Credit Agricole Bel...

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Chul Cheong, Rep. of KOREA

CHUL CHEONG Professor Seoul Venture University Education- Berlin University Dept. of Brewing Technology (2002, Ph. D.)- Munich University Dept. of Food science (1996-, Master's degree)- Inha University Dept. of Food and Nutrition (1989, Bachelor's degree) Professional Experience - ...

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Shuangping Liu, CHINA

[Shuangping Liu 劉雙平 Associate professor School of Food Science and Technology, Jiangnan University Academic Position 2015 - current: Associate professor in Food science and technology \(Pro Jian Mao' team\) , Jiangnan University \(China\). Courses on food microbiology and Chinese traditional f...](#)

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Wen-Ching Ko, TAIWAN

Wen-Ching Ko Chair Professor, Dept. of Food Science and Biotechnology, Da Yeh University Education- Food Science, National Chung Hsing University (Bachelor, 1974, Taiwan)- Food Science, National Chung Hsing University (Master, 1986, Taiwan)- Tokyo University of Fisheries (Doctor, 1991, Japan)...

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Ida Bagus Wayan Gunam, INDONESIA

Ida Bagus Wayan Gunam Head of Bio-industry and Environmental Laboratory Udayana University Education 1. B.Sc. (Ir.) in Food Technology and Nutrition (Bogor Agricultural University, 1986) 2. M.Sc. (MP.) in Food Science and Technology (Gadjah Mada University, 1997) 3. Ph.D. in Applied Bioscience (...)

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Heui-Yun KANG, Rep. of KOREA

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Program

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| 제목 | SOOL 2018, Program (English) | 등록일 | -0001.11.30 00:00 |
| 글쓴이 | CLERK | 조회 | 95 |

International Sool Conference, Seoul 2018
 Rice Farming Culture and Alcoholic Rice Beverage Industry
 — A New Framework and Plans for the Future

November, 23rd(Fri) 09:00~17:30, 24th(Sat) 09:00~12:30
 Grand Conference Hall, 1F., Building No.201,
 College of Agriculture and Life Sciences (CALS), Seoul National University

| November 23rd (Fri.) | |
|----------------------|---|
| 08:30-9:00 | Registration |
| 09:00-9:10 | Welcoming Address: Dae Yung Jeung , Chairman of Korea Sool Institute Congratulatory Remarks: Soojin Park , Director of Seoul National University Asia Center |

Event

- Special Lecture
- Design Exhibit
- How to make Sool

coming Sool

- What is Sool?
- Sool Festival
- Postscript

| November 23rd (Fri.) | |
|--|--|
| 09:10-09:25 | Keynote Speaker : Tae Young Kim , Former Agriculture Researcher of the Rural Development Administration |
| 09:30-10:05 | Grains, the Campaign for Abstinence from Alcohol and Liquor Taxes: The Modernity of East Asian Alcohols = Young-Ha Joo , The Academy of Korean Studies |
| 10:10-10:45 | Uncorking the past: alcoholic fermentation as humankind's first biotechnology = Patrick E. McGovern , University of Pennsylvania |
| 10:50-11:25 | Supply and Demand of Rice and Brewing Industry in Modern Korea: a Technology Historian's View = Tae Ho Kim , Chonbuk National University |
| 11:30-13:10 | Lunch |
| Session 2. "Rice Farming and Alcoholic Rice Beverage Industry in Asia" | |
| 13:10-13:45 | Recent Advances in China on alcoholic rice beverages = Shuangping Liu , Jiangnan University |
| 13:50-14:25 | Rice Farming and History of Making Traditional Indonesian Alcoholic Beverage = Ida Bagus Wayan Gunam , Udayana University |
| 14:30-15:00 | Break with Refreshments |
| 15:00-15:35 | Vietnamese Alcoholic Rice Beverage and its Potential Development = Van Viet Man LE , Ho Chi Minh City University of Technology |
| 15:40-16:15 | Introduction to Taiwanese Alcoholic Rice Beverages and the Perspective on Its Future Development = Wen-Ching Ko , Da-Yeh University |
| 16:20-16:55 | Rice Farming and Alcohol Beverage Industry in the Republic of Korea = Chul Cheong , Seoul Venture University |
| 17:00-17:30 | Questions and Answers for the Audience |
| November 24th (Sat.) | |
| 08:30-9:00 | Registration |
| Session 3. "The Prospect of Alcoholic Rice Beverage" | |
| 09:00-9:35 | Comparison of Brewing Method of the Major Alcoholic Beverages in the World: Wine, Beer, Sake, and Sool = Heui Yun Kang , Gyeonggido Agricultural Research and Extension Service |
| 09:40-10:15 | The Case of Industrialization of Wine Cluster in European Union and Economic Value of A.O.C. = Henri de Dampierre , Chateau De Plascac |
| 10:20-10:40 | Break with refreshments |
| 10:40-11:15 | Market Developments and Product Improvements in the Lambic Beer Industry since 1990 = Yves Panneels , The Gueuze Society |
| 11:20-11:55 | Branding of Korean Alcoholic Beverages: Its Meaning and Outlook = Sunook Park , California State University, Long Beach (CSULB), Seoul National University Asia Center (SNUAC) |
| 12:00-12:30 | Questions and Answers for the Audience Closing Remarks |

Event

- Special Lecture
- Design Exhibit
- How to make Sool

coming Sool

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Rice Farming and History of Making Traditional Indonesian Alcoholic Beverage

Ida Bagus Wayan Gunam^{a*}, Nyoman Semadi Antara^a, I Dewa Gede Mayun Permana^b, I Nengah Sujaya^c

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ABSTRACT

Rice is the most important agricultural products in Indonesia, with over 200 million people relying on it as a staple food. The rice production has been fully supported by improved infrastructure, supply of seeds, fertilizers, research and development as well as government regulations in pricing. Its vulnerability to climate change requires adaptation strategies for irrigation, biotechnology, and cultivar selection. Recent forms of agricultural policy in Indonesia include the deployment and implementation of environmentally friendly technologies, with the aim to reduce the use of chemicals. The agricultural irrigation system that has existed since ancient times and is still relevant today is the *Subak* irrigation system; this system is able to maintain the existence of agricultural water and environmental sustainability. Rice production in Indonesia continues to increase from year to year and it reached 81.38 million tons in 2017, including glutinous rice. With the increase in population, the need for rice also increases both for food consumption and as raw materials for the food and non-food industries, as well as other forms of consumption. With the food self-sufficiency program, rice production will continue to be improved. Glutinous rice, both black and white, is widely used as a raw material for the production of alcoholic beverages (rice wine). Traditional alcoholic beverages are ancient art products that are found naturally. They become parts of human culture, tradition, and civilization as an integral part of many ceremonies, symbolism in rituals, and celebrations. Some of the traditional rice wine products in Indonesia such as *brem*, *arak*, and *tuak* were originally made for ceremonial/ritual and celebrations purposes but developed into a favorite drink and even have become a promising commercial product. Therefore, knowledge of fermentation technology, selection of raw materials, and a starter culture will provide better product quality. This can reduce losses and increase sales, so it is becoming a good source of revenue for the household, industry, state, and national levels. Furthermore, improvements in product performance, promotion, and marketing will have a positive impact on the development of alcoholic beverages with rice as the raw material in the future.

Keywords: Rice farming, *subak*, alcoholic beverage, rice wine.

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Rice Farming and History of Making Traditional Indonesian Alcoholic Beverage



**Ida Bagus Wayan Gunam, Nyoman Semadi Antara,
I Dewa Gede Mayun Permana, I Nengah Sujaya
Faculty of Agriculture Technology
UDAYANA UNIVERSITY
Bali, INDONESIA**

OUTLINE OF PRESENTATION



Introduction



Rice farming in Indonesia



History of traditional Indonesian alcoholic beverage



Making of traditional Indonesian alcoholic beverages

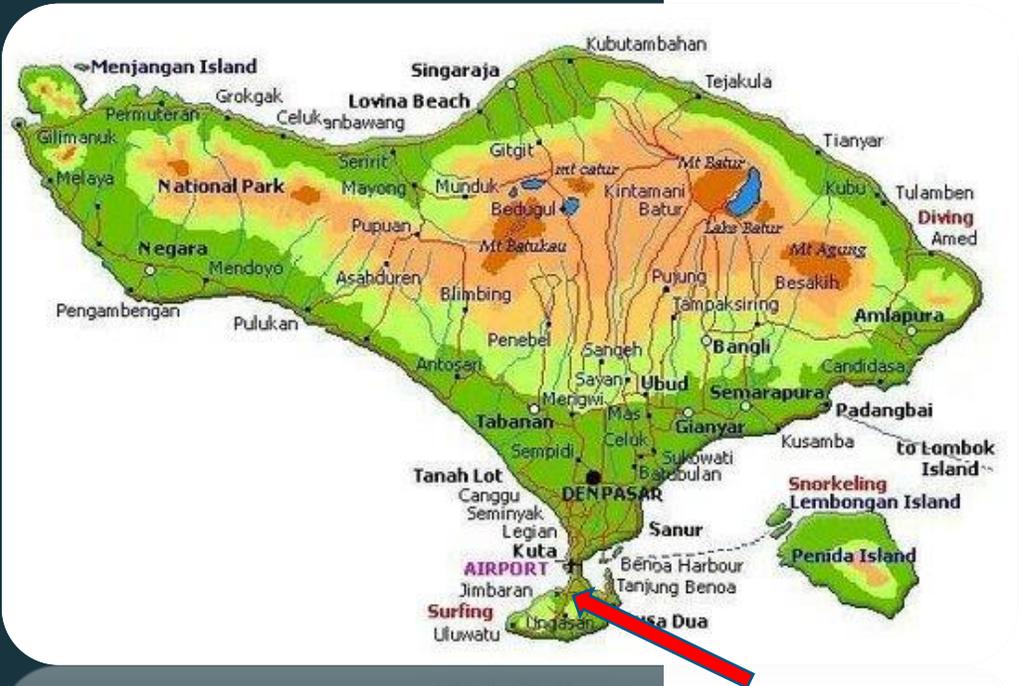


Conclusion



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Bali Island



INTRODUCTION



Table 1.1 Rice production in the world
Source: FAOSTAT Data December 2014

| Country | Production Volume |
|------------------|-------------------|
| China | 208,100,000 |
| India | 155,500,000 |
| Indonesia | 70,600,000 |
| Bangladesh | 52,400,000 |
| Vietnam | 44,900,000 |
| World | 741,500,000 |

- Indonesia is an archipelagic country that is widespread from 17,500 islands, with a population of 265,015,000 (BPS, 2018).
- With a diverse tropical environment and plentiful annual precipitation. The volcanic origin of the archipelago provided vast areas of fertile soils which support both dense tropical rainforest and agriculture.
- Rice is the most important staple food in Indonesia, with over 200 million people relying on rice as a staple food
- Indonesia ranks 3rd in the world in regards to total rice production but has also been the world's 7th largest rice importer over the past 5 years (USDA, 2012).
- Concurrently, domestic rice consumption has been increasing each year as a result of dietary changes associated with population growth and economic development, making Indonesia a leading global rice consumer (USDA, 2015).
- Owing to the perennial shortfall of rice production, food security and the pursuit of national rice self-sufficiency have become predominant concerns of the Indonesian government.

Rice production & consumption in Indonesia



Source: BPS (2015)
Note: 2015 Data is second
Forecast Figure (ARAM II)

Historical rice yields and consumption

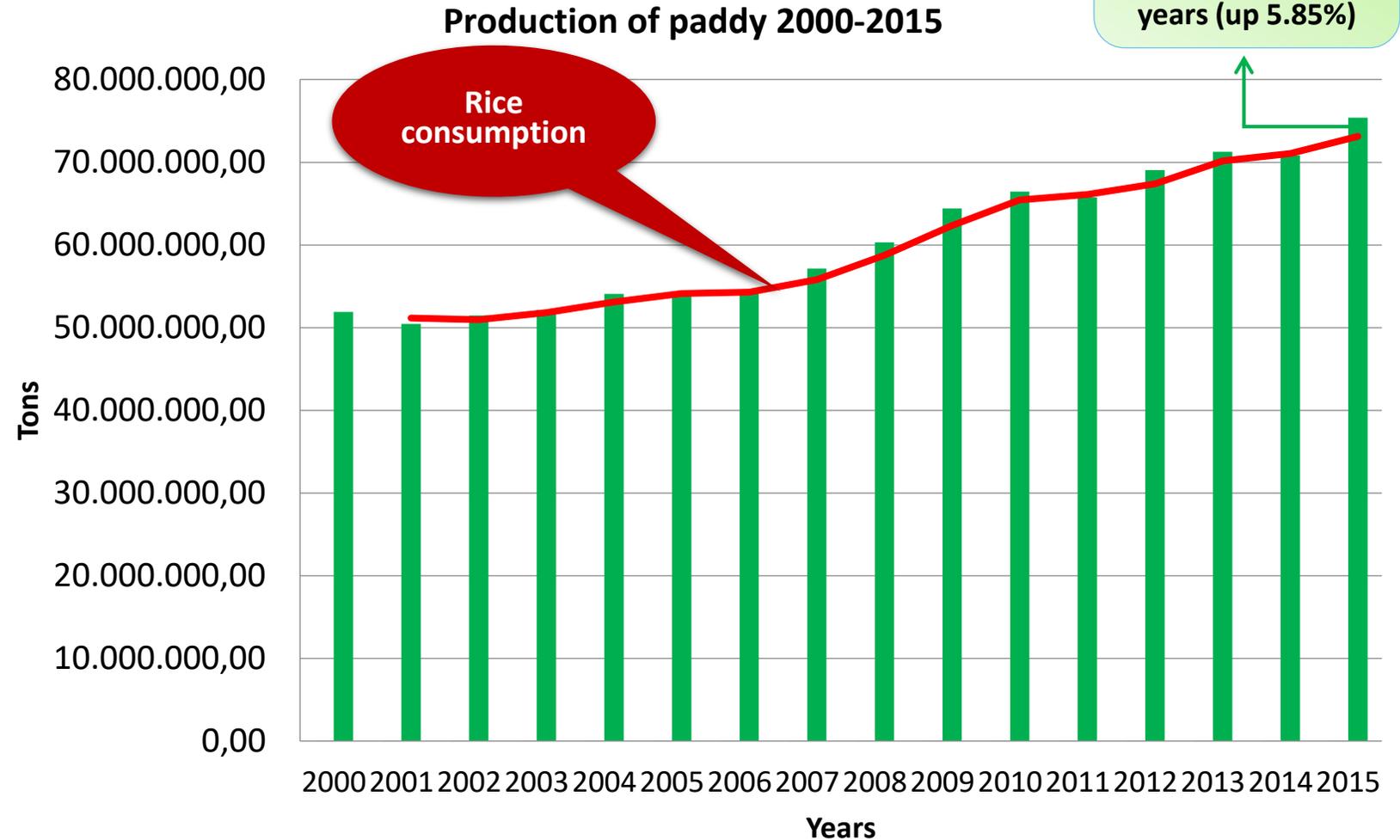


Fig. 1.2 Production of paddy (2000-2015)

Rice farming methods & product development

- To increase paddy production the Indonesian Government has carried out various efforts including increasing budgets, increasing human resources, providing fertilizer, developing integrated pest control, developing more productive and environmentally friendly farming methods, developing local and new varieties.
- Climate change-resistant farming methods: Green Revolution, The System of Rice Intensification (SRI), and one of the old ways that are still relevant today is the **Subak** irrigation system.
- In addition to increasing rice production (including glutinous rice), post-harvest handling, processing, and marketing of products are also being developed.
- **Traditional food and beverages** that develop in the community, including fermented products, need to get the attention of all parties.
- Fermented traditional drinks (**alcoholic beverages**) used in the past are used as a means of religious ceremonies / rituals, symbolism, celebrations, and finally become a favorite beverage that can be commercialized.

Rice farming in Indonesia

History of rice farming in Indonesia

- International Rice Research Institute (IRRI) scientists indicate that rice was first introduced to Indonesia in about 1500BC, and has been under continuous cultivation for the past 3,500 years. Rice is by far the most important food crop grown in Indonesia today (USDA, 2012).

Rice farming area

- Almost all islands in the Indonesian archipelago can be planted with rice, but the most are in Java, Sumatera, Sulawesi and Bali-Nusra. The total area of rice in Indonesia is 13.39 million Ha (Kementrian Pertanian, 2015).
- Total agricultural land in 2010 was estimated by the Indonesian government (BPS) at roughly 22 percent of the total land area in the country.

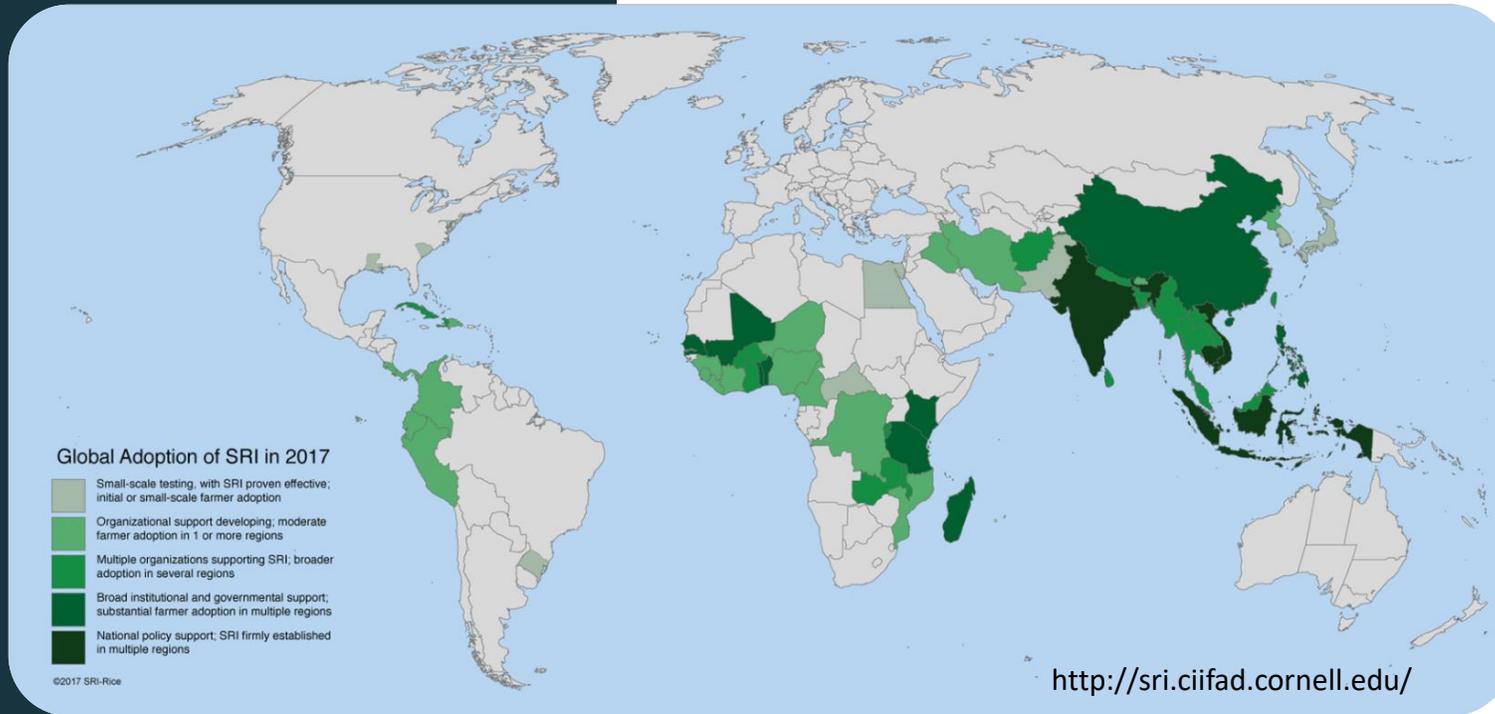
Farming Methods

- SRI in the field it is able to increase rice production significantly, provide good product quality, and achieve a high level of plant independence (Purwasasmita and Sutaryat, 2018).
- The “Green Revolution,” wherein new high-yielding cultivars were developed along with improved farming systems to significantly increase cropping intensity and yield (USDA, 2012).
- SUBAK a traditional irrigation system (Lansing, 2007).

Rice farming in Indonesia

Varieties

- New varieties have been developed that are adaptive to certain agroecosystems (BB Padi, 2017). Besides that the government is also still developing local varieties such as glutinous rice, brown rice, black rice that have certain advantages.



The System of Rice Intensification (SRI)

- SRI is an evolving set of practices, principles, and philosophies aimed at increasing the productivity of irrigated rice by changing the management of plants, soil, water and nutrients.
- To increase Indonesia's productivity also has implemented The System of Rice Intensification (SRI) (Fig. 2.1). To succeed, still need a lot of adjustments and improvements.

Fig. 2.1 Indonesia adaption of The System of Rice Intensification (SRI).

SUBAK is one of the rice farming irrigation systems in Indonesia

- Bali is in some ways typical of other agricultural areas in the region, but it is also a special case because of its distinctive economic and cultural environment dominated by tourism. In this environment, farmers are doubly marginalized. At the same time the island offers them unique market opportunities for premium and organic produce (MacRae, 2011).
- ***Subak*** is a traditional local organization concerned primarily with irrigation and the ritual aspects of rice production.
- The agricultural irrigation system that have existed since ancient times and still relevant today (Lansing, 1987).
- This system able to maintain the existence of agricultural water and environmental sustainability (Yuliana, *et al.* 2017)

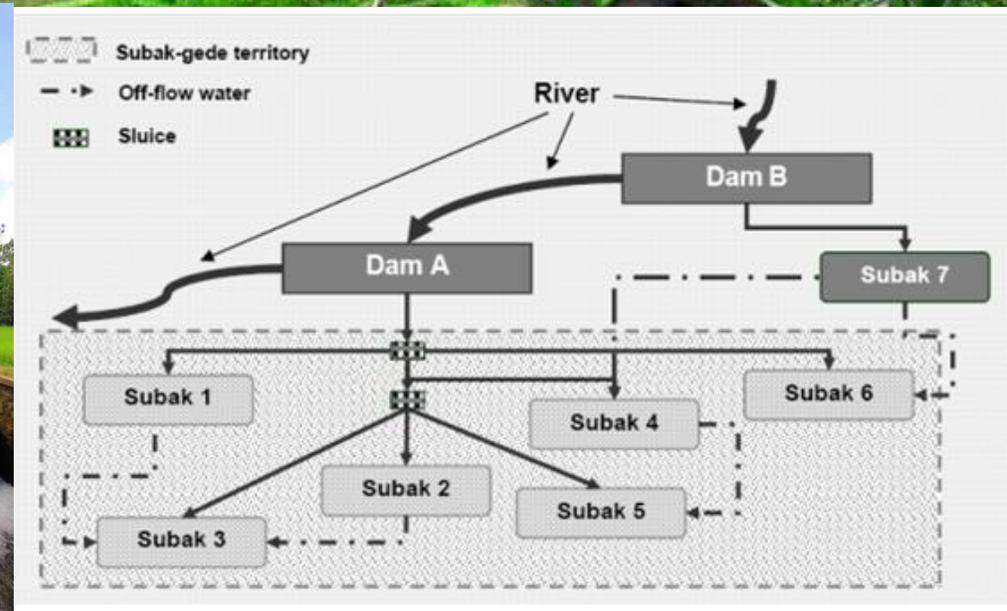


Fig. 2.2 Examples of Subak Gede Spatial Schemes (Lorenzen (2006))

Subak model

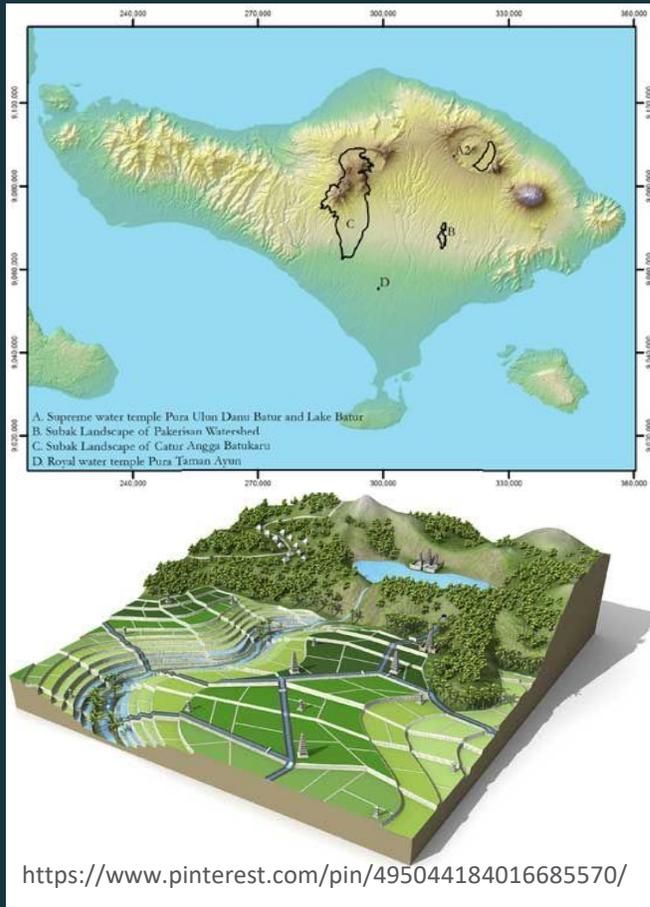


Fig. 2.3 the main water source of subak in Bali
Source: UNESCO official website

- In 1987, J. Stephen Lansing cooperate with farmers in Bali has redeveloped in the irrigation system/*Subak* irrigation becomes more effective. That way he can prove how the effectiveness and importance of *Subak* irrigation method in Bali.
- Of the regions investigated in Indonesia, rice production in Bali has been the most efficient (Mariyono, 2014).
- Since 2012 has become the UN recognized World Cultural Heritage for Education, Knowledge and Culture (UNESCO) (Kompas.com, 2012)
- The determination as a World Cultural Heritage was welcomed by the government and the people of Bali. According to the filing, *Subak* in Bali which has an area of approximately 20,000 ha, consisting of a water control system that is in 5 districts of Badung, Bangli, Buleleng, Gianyar and Tabanan.
- **Subak model:** The components of *Subak* is covering the forests that protect water supplies, landscapes of terraced rice fields that are connected by a system of canals, tunnels and dams, villages, temples of various sizes indicating the importance of water resources or water flowing through the temple declined irrigating water control system.

Subak Landcape



Figure 2.4. Landscape of traditional paddy *terasering* by *Subak* integrated system (*Subak Jatiluwih*). Paddy is cultivated near the river and hill at Petanu village.



Subak Festival



Figure 2.5. 2nd Subak Festival at Bugbug, Karangasem Regency, Bali.

History of Indonesian food and traditional fermented alcoholic beverage

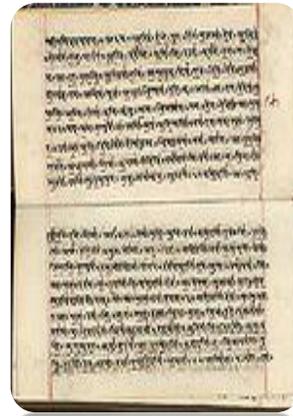


Fig. 3.1a The religious text

- In the past, along with the coming of civilization from India to Indonesia, there were many traditions which were carried along such as in terms of farming, postharvest handling, processing of agricultural products and traditions in religious rituals, celebrations, etc.
- The religious text of the **Vedas (Rig Veda)** mentions at least one alcoholic beverage that might be related to wine (*ura*) is a type of rice wine fermented with honey (Sing *et al.*, 2012).
- About wine there are also at the **Prambanan** Temple reliefs, **Borobudur** Temple & other temples.



Fig. 3.1b The religious text (Lontar/palm leaves)



Fig. 3.2 A. Prambanan Temple Relief; B. The ceremony of *Tawur Agung* at Prambanan Temple.

History of Indonesian food and traditional fermented alcoholic beverage

- ❁ Indonesians, especially Balinese, carry out the religious ceremonies in the form of offerings as a thank you for the success of harvesting agricultural products at certain times.
- ❁ Hinduism people praying with *Banten* offerings are not only dedicated to the gods alone, for the Balinese also prepare offerings for the demons (*bhūtas*) to whom are given meat and **alcoholic beverages**.
- ❁ *Bantens* consist of several meals, fruits and other food, which are then placed on one or more dishes.
- ❁ Places the *bantens* for the Gods on high altars whereas he puts those for the Demons on the ground.
- ❁ Before and after praying with offering, the “**tetabuhan**” (**Tuak, Arak, Brem** and Plain Water) are usually sprinkled.

“BANTEN” as Balinese offering



<http://www.booking-bali-villas.com/bali/bahasa-bali/>



Fig. 3.4 Canang sari



Fig. 3.5 Segehan with tape ketan & brem



Fig. 3.6 The people bring offerings (banten) to the temple

Brem

Tape ketan

Praying with *metabuhan*

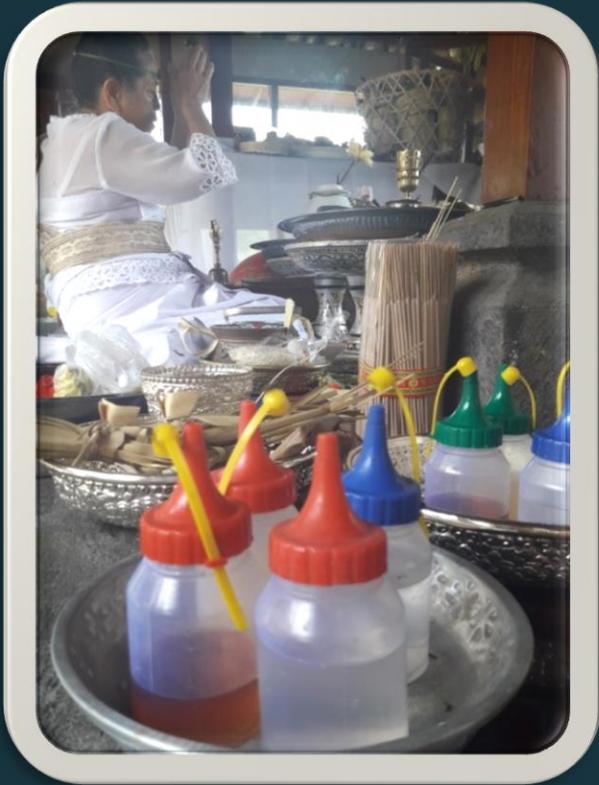


Fig. 3.9 Alcoholic beverage containers for a daily ritual



Fig. 3.7 A. containers for *Tuak*, *Arak*, *Brem*, and *Water*, B. When used in worship



Fig. 3.8 Canang and segehan equipped with *tuak*, *arak*, *brem* and *water* (for *buta kala*)

Food products and alcoholic beverages used in religious ceremonies, festivals and celebrations, etc.



Fig. 3.11 *Some Ribek*: a religious ceremonies in barns or rice storage areas.



Fig. 3.10 **A.** Shrine in Rice Field; **B.** Performing religious rituals in the rice fields. (<https://loisandgeorge2012.wordpress.com/tag/balinese-ceremonies/>)

***Tuak, Arak, & Brem* in Bali as a means of religious ceremonies**

Now it has developed into a favorite drink and even becomes an international drink

- Since ancient times, local alcoholic drinks have been developed by indigenous people in the archipelago. Some panels in the 9th century of ***Borobudur Temple*** depicted drink sellers, small shops, and there were panels that depicted a building with people drinking (maybe alcoholic drinks), dancing and having fun, as if describing a tavern or inn.
- Initially alcoholic drinks were made for Hinduism ceremonies both in India, Indonesia including in Bali. ***Tuak, Arak*** and ***Brem*** are needed for ***tabuhan*** wasps (offerings) to the gods and “*butha kala*”.
- ***Brem, Arak*** and ***Tuak*** are popular drinks on the island of Bali which are predominantly Hindu. ***Brem*** is a brownish liquor with 5-14% alcohol. This product is exported to Japan and China.

The tradition of drinking alcoholic beverages in the past



Fig. 3.13 Balinese *Tuak* (palm wine) container lid

Fig. 3.12 the tradition of drinking tuak



<https://nusantara.news/nitik-tradisi-leluhur-minum-tuak-bala-ngombe-tuban/>

Wooden palm wine container lid from Bali. This lid is placed on the top of a Bamboo container. Early 20th century

<http://www.karlssonandwickman.com/tribal-art-page-2/stbkfhfj1gk3oy5omaynamhr5chlp0>

Fermented glutinous rice and palm juices



Regulation of Alcoholic Beverages in Indonesia: Classified alcoholic beverages in Indonesia in three categories. Drinks having an alcohol percentage less than 5% (A class), 5%–20% (B class) and more than 20% (C class).

Table 4.1. Ethnic fermented alcoholic beverages of Indonesia

| Foods/Product name | Substrates/ Mayor ingredien | Nature and uses | Microorganisms | Regions of consumption in Indonesia | References | Appearance |
|---|--|-------------------------|--|---|---|-----------------------------------|
| Brem (angur beras / rice wine) | Glutinous rice, Cassava | Ritual Snack, Beverages | <i>Rz. oryzae</i> , <i>M. rouxii</i> , <i>A. oryzae</i> , <i>S. cerevisiae</i> , <i>A. aceti</i> <i>Mucor indicus</i> <i>Candida</i> | Central of Java, Bali, Lombok | Basuki (1977), Saono et al. (1984), Aryanta (2000) Sujaya et al., 2004) | Dark brown liquid sour, alcoholic |
| <i>Sopi</i> | Juice of plant (<i>Arenga pinnata</i>) | Ritual Beverages | <i>S. cerevisiae</i> , | Flores, Maluku, dan Indonesia bagian timur lainnya | https://www.idntimes.com/travel/tips/francisca-christy/7-minuman-tradisional-beralkohol-1/full | Clear liquid |
| <i>Tuak (Toddy)</i> | Juice of plant; Glutinous rice | Ritual Beverages | <i>S. cerevisiae</i> , <i>C. tropicalis</i> | North Sumatra, Nusa Tenggara Borneo, Bali, Lombok | Hermansyah et al. (2015) | Turbid drink Sour, sweet liquid, |
| <i>Ballo</i> | Juice of <i>Nypa fruticans</i> (Nipah), <i>Arenga piñata</i> , <i>Borassus flabellifer (lontar)</i> , rice | Beverages, celebration | <i>S. cerevisiae</i> | Sulawesi Selatan, Toraja, | Hermansyah et al. (2015) | Turbid drink Sour, sweet liquid, |
| <i>Arak (samsu), Cap Tikus</i> | Juice of plant; Glutinous rice, gula merah | Beverages, Ritual | <i>S. cerevisiae</i> , <i>C. tropicalis</i> | Java, Bali, Lombok, Nusa Tenggara, Sulawesi, Minahasa | https://www.idntimes.com/travel/tips/francisca-christy/7-minuman-tradisional-beralkohol-1/full | Clear liquid |
| <i>Ciu Bekonang /Ciu Banyumas Spirit,</i> | Cane sugar, Palm sugar, <i>omplong</i> , <i>tape singkong</i> , water | Beverage, celebration | <i>S. cerevisiae</i> | Sukoharjo, Banyumas (Central of Java) | https://sportourism.id/explore/mengintip-tradisi-pembuatan-ciu-di-desa-bekonang | Clear liquid alcoholic |
| Alcoholic rice paste: Tape & Brem cake | Glutinous rice | snack | <i>A. rouxii</i> , <i>E. burtonii</i> , <i>E. fenulinger</i> , | Java, Sumatera, Bali | Lee and Lee (2002), Owens (2015) | Sweet/sour alcoholic paste |

4.1 RICE WINE

Rice Alcoholic Fermentation Starters

Table 4.2 The constituent component of *ragi tape*

| Component | Amount (% of Rice) |
|-------------------|-----------------------|
| Rice | 100 |
| Garlic | 0.50-18.70 |
| White pepper | 0.05-6.20 |
| Galangal | 2.50-50.00 |
| Red chili | 0.25-6.20 |
| Cinnamon | 0.05-3.50 |
| Black pepper | 0.30-2.50 |
| Fennel | 2.50-3.00 |
| Sugar cane juices | 1.00-12.50 |
| Lime | 2.50 |
| Coconut water | 50.00 |

Making Ragi & Tape Ketan



Traditions in the conventional handling, preservation and application of starter cultures

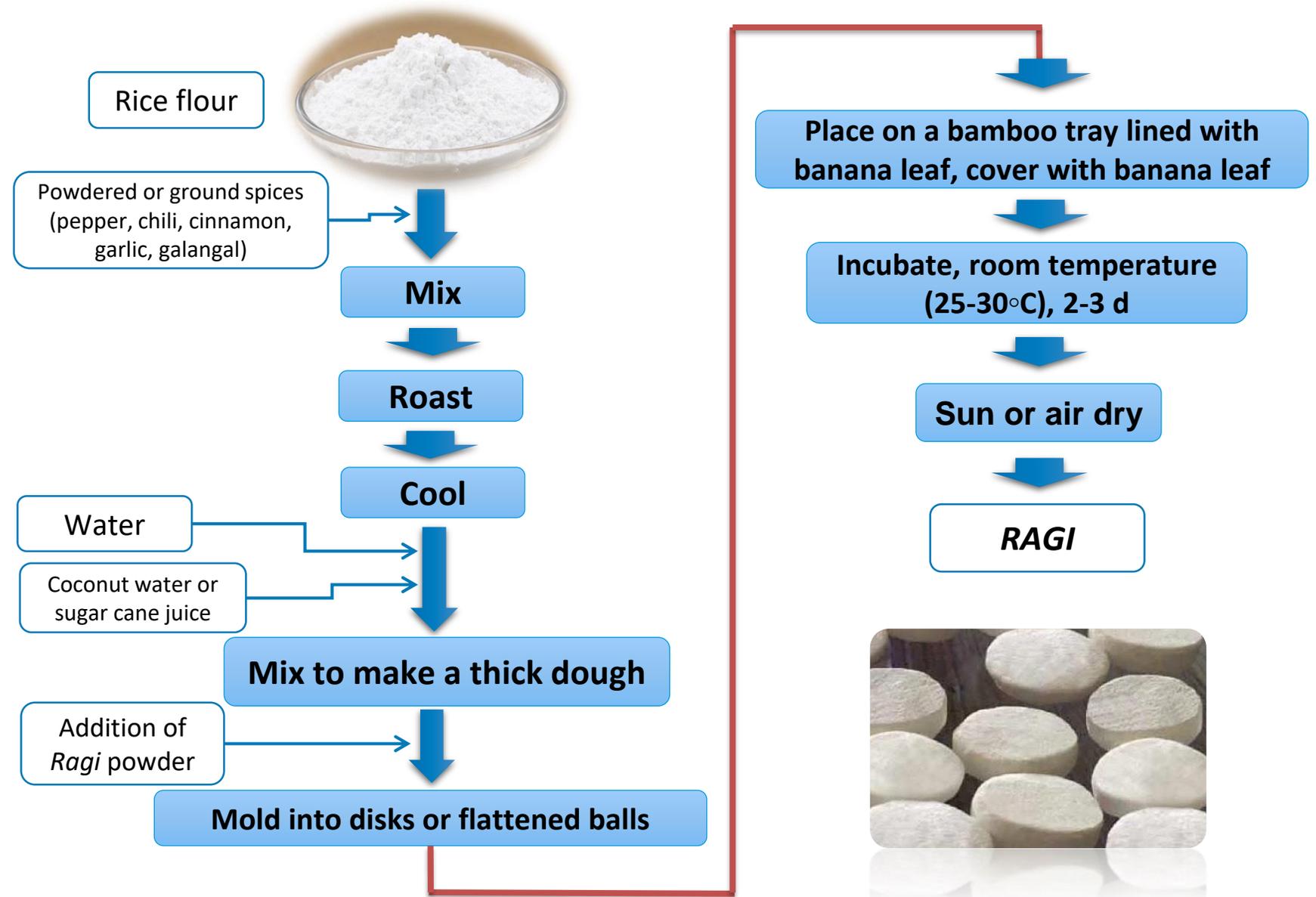


Fig. 4.1 Flow charts for the preparation of solid-fermented starters (Nuraida, 2016)

Raw materials of *RICE WINE* production



Ragi tape



White glutinous rice
(*Oryza sativa glutinosa*)



Black glutinous rice
(*O. sativa L.*)

Ragi tape:

Weighs \pm 3 g round flat shape,
1 pieces for 1 kg glutinous rice

Additional ingredient:

- Water
- Marinade
- Nutrient/ Mineral source

Composition of Glutinous Rice:

- Carbohydrate : 79.4% : 78%
- Protein : 6.7% : 7%
- Fat : 0.7% : 0.7%
- Ca : 0.012% : 0.010%
- Fe : 0.008% : 0.001%
- P : 0.148% : 0.148%
- Vitamin B : 0.0002%:
- Water content : 12%

**Fig. 4.2 Materials for making
rice wine**

Various brands of ragi tape



Ragi Tape is a dry starter: (much ragi is sold without any brand name)

Ragi is off-white in color & shaped into small disks or flattened balls about 2-3 cm in diameter.

Ragi tape is made from: Rice starch, garlic, chili, white pepper, fennel, etc.

Place: Cianjur, Cirebon, Solo, etc. (Java island).

Used for:

Making sticky tape and cassava tape: it tastes sweet, fragrant and tastes good

For Japanese ant feed: Japanese ants can be used as medicine when the Japanese ants are fed ragi tape

Fig. 4.3 Ragi tape brand

Microbiology of Ragi Tape

Table 4.3 Microbiology of *ragi* tape

| Microbial Group | Genera/Species | References | Genera/Species Bacteria | References |
|--|-----------------------------|---|--------------------------------|--------------------------------|
| Molds | <i>Amylomyces rouxii</i> | Ko (1972); Ardhana & Fleet (1989) | <i>Bacillus coagulans</i> | Ardhana & Fleet (1989) |
| | <i>Rhizopus</i> sp. | Ko (1972) | <i>B. Brevis</i> | Ardhana & Fleet (1989) |
| | <i>Mucor</i> sp. | Ko (1972) | <i>B. stearothermophilus</i> | Ardhana & Fleet (1989) |
| | <i>Mucor circinelloides</i> | Saono <i>et al.</i> , (1974) | <i>Acetobacter</i> sp. | Ardhana & Fleet (1989) |
| | <i>M. rouxii</i> | Saono <i>et al.</i> , (1974) | <i>Pediococcus pentosaceus</i> | Sujaya <i>et al.</i> , (2002) |
| | <i>M. javanicus</i> | Saono <i>et al.</i> , (1974) | <i>Wisella</i> spp. | Sujaya <i>et al.</i> , (2002) |
| | <i>R. oryzae</i> | Saono <i>et al.</i> , (1974) | <i>Lactobacillus</i> spp. | Sujaya <i>et al.</i> , (2010) |
| | <i>Fusarium</i> sp. | Saono <i>et al.</i> , (1974) | <i>Enterococcus</i> spp. | Sujaya <i>et al.</i> , (2010) |
| | Yeasts | <i>Endomycopsis</i> | Ko (1972) | <i>Clostridium perfringens</i> |
| <i>Saccharomycopsis</i> sp. | | Ko (1972); Saono <i>et al.</i> (74) | | |
| <i>Asterotremella humicola</i> | | Saono <i>et al.</i> , (1974) | | |
| <i>Candida</i> sp. | | Saono <i>et al.</i> , (1974) | | |
| <i>C. guilliermondii</i> | | Saono <i>et al.</i> , (1974) | | |
| <i>C. japinica</i> (<i>F. capsuligenum</i>) | | Saono <i>et al.</i> , (1974) | | |
| <i>C. intermedia</i> | | Saono <i>et al.</i> , (1974) | | |
| <i>C. parapsilosis</i> | | Saono <i>et al.</i> , (1974) | | |
| <i>C. solani</i> | | Saono <i>et al.</i> , (1974) | | |
| <i>C. pelliculosa.</i> <i>C. anomala</i> | | Saono <i>et al.</i> , (1974); Ardhana & Fleet (1989) | | |

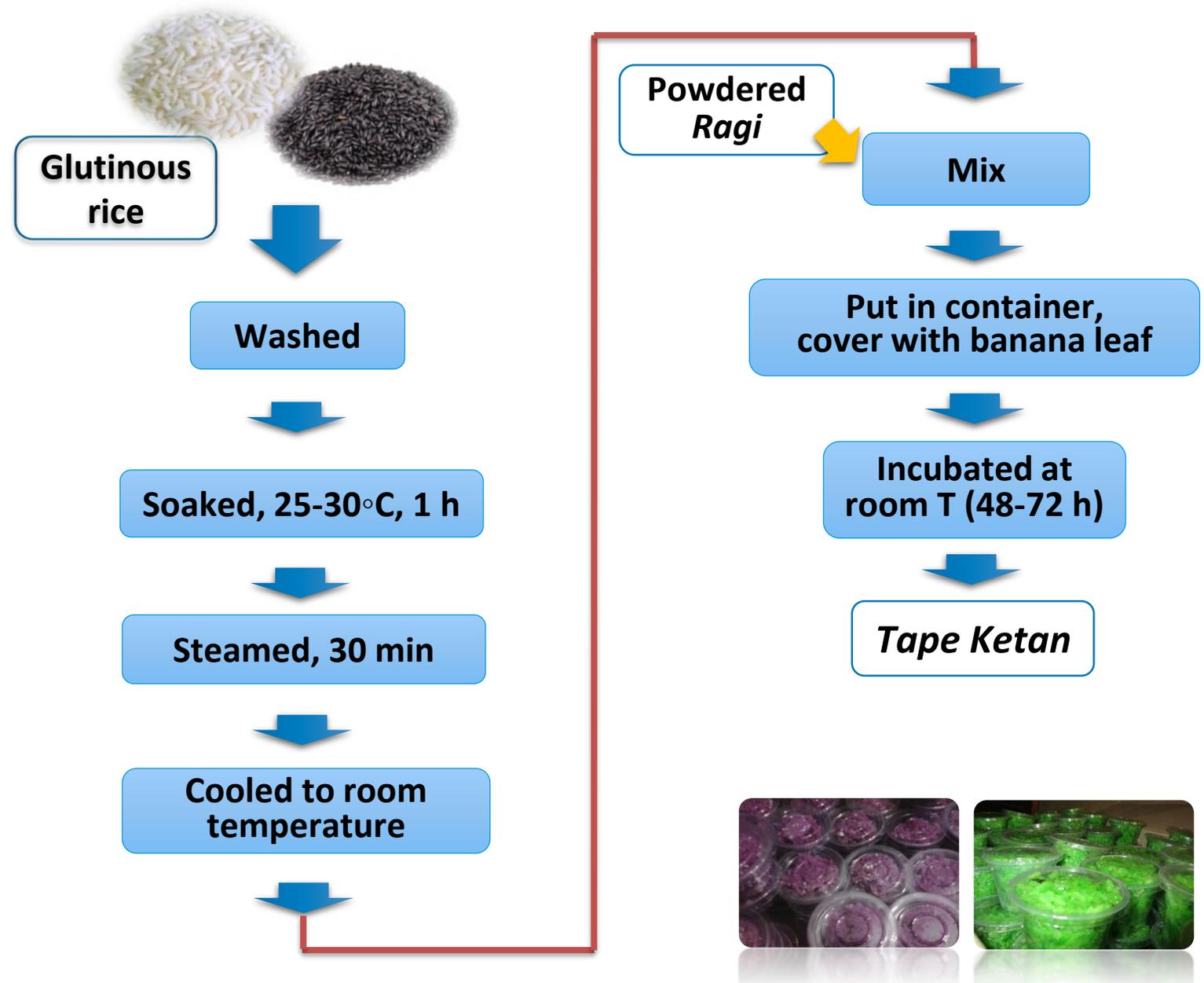


Microbiology of *ragi*

Flow chart of “*tape ketan*” production

- *Tape ketan* is a traditional Indonesian fermented food that is produced across Indonesia.
- Two types of *tape ketan*: black & white); with *Pandanus amarylifolius*, etc.)

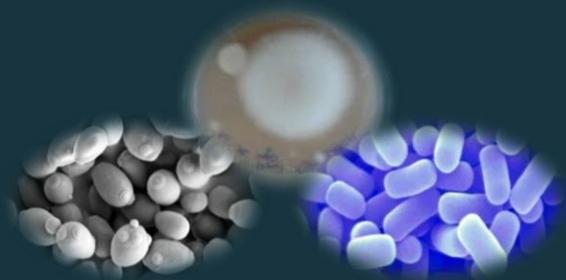
Fig. 4.4 Flow chart for the manufacture of Indonesian *tape ketan* (Saono et. al. 1986; Nuraida & Owens, 2015)



Microbiology of Tape Ketan

Table 4.5 Microbiology of *tape ketan*

| Microbial group | Genera/Species | References |
|-----------------|---|--|
| Molds | <i>Amylomyces rouxii</i> (<i>R. arrhizus</i>) | Djien (1972); Cronk <i>et al.</i> (1977); Ardhana & Fleet (1989) (Amylolitic) |
| Yeast | <i>Hyphopichia burtonii</i> (<i>Endomycopsis burtonii</i>) | Cronk <i>et al.</i> (1977): |
| | <i>Saccharomyces fibuligera</i> (<i>Endomycopsis fibuligera</i>) | Djien (1972); |
| | <i>Candida beverwijkiae</i> (<i>C. pellicullosa</i>) | Ardhana & Fleet (1989) (as the dominant yeast in <i>tape</i> , amylolitic) |
| | <i>S. cerevisiae</i> | Ardhana & Fleet (1989) |
| | <i>Wickerhamomyces anomalus</i> (<i>Hansenula anomala</i>) | Ardhana & Fleet (1989) (intolerant of high ethanol) |
| Bacteria | - | - |



4.2 BREM

The microbial ecology of *tape* fermentation



Solid Brem



Liquid Brem

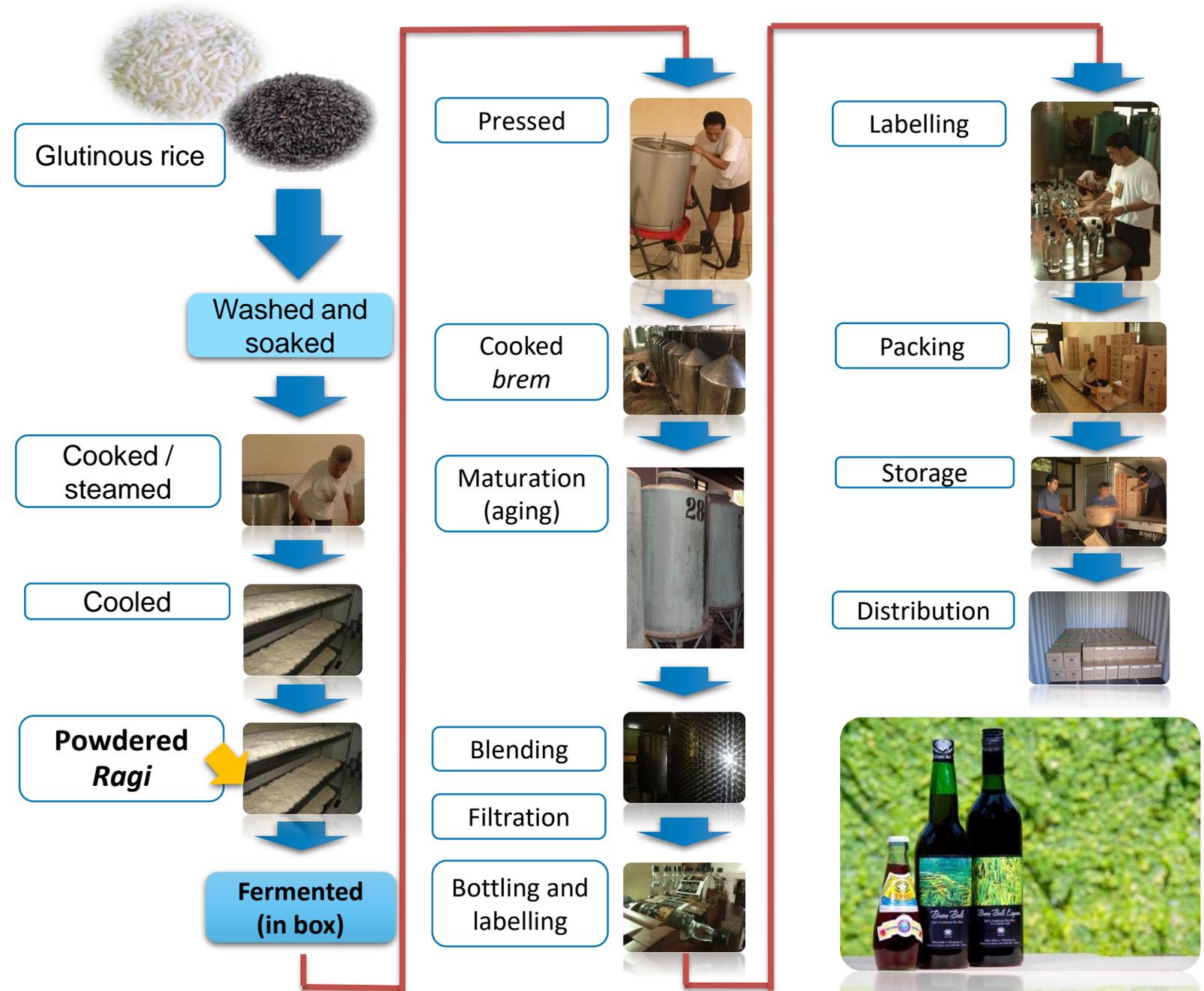
Fig. 4.5 Brem products

- *Brem* products are of two types: solid and liquid (lots of solid *brem* are produced in Java; liquid *brem* are produced in Bali and Lombok Island)
- Solid and liquid *brem* are made beginning with *tape ketan* fermentation (solid *brem*: white sticky rice; liquid *brem*: white and black sticky rice).
- Solid *brem* of fermented liquid is then cooked until a semi-viscous liquid is obtained and dried. Liquid *brem*: second fermented with *S. cerevisiae*, aging and bottled.
- Saccharification of starch and sugar fermentation occur simultaneously (parallel) due to the presence of *Aspergillus*, *Rhizopus* and other amylolytic fungal species, *Saccharomyces cerevisiae* and other yeasts.

Manufacturing *Brem*



Fig. 4.6 Flow chart of *Brem* Bali production



Microbiology: *Brem*



- ❖ The microorganisms found in *ragi tape* include the fungi *Rhizopus*, *Mucor* and *Amylomyces*, the yeasts *Saccharomycopsis fibuligera* and *Pichia anomala*, and various lactic acid bacteria (Holzapfel, 2002), although the predominant species in brem is *Saccharomyces cerevisiae*, which possesses high fermentation activity (Sujaya *et al.*, 2004).
- ❖ The *S. cerevisiae* strains were divided into four types based on the pattern of chromosomal DNA binding, and each type produced *brem* with different organic acids and volatile compounds when used as single strains (Sujaya *et al.*, 2004).

4.3 ARAK

(White glutinous rice)



Fig. 4.8 Flow chart of ARAK production

Rice-based "ARAK" products:

*Dewi Sri, Pura, Nikki,
Tiga Bintang, Legong,
Jablay, etc.*

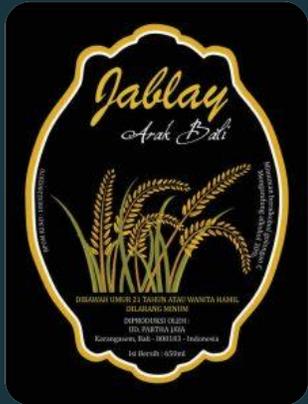


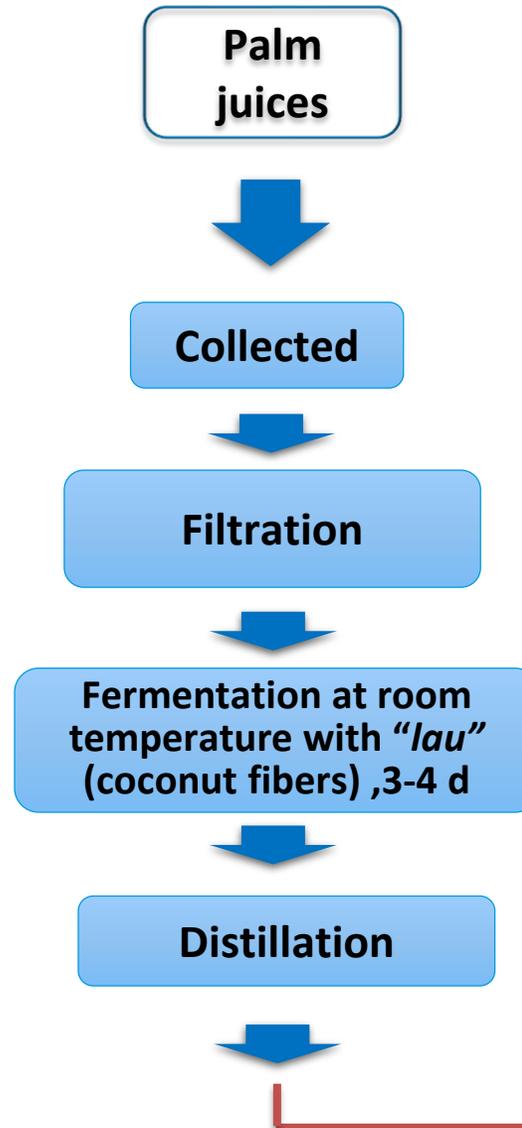
Fig. 4.9 Various arak brands



Traditional ARAK production (palm juices)



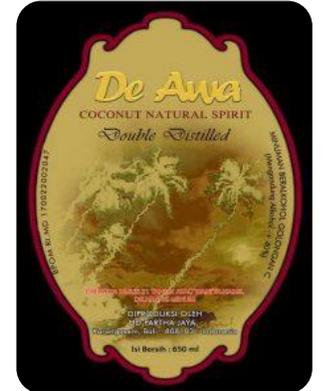
Fig. 4.10 Flow chart for the Traditional Indonesian *arak* based palm juices



ARAK
(35-40% alcohol)



<http://nowbali.co.id/the-indigenous-balinese-arak/>



De'Awa is a coconut palm-based Balinese Arak.



<https://travel.kompas.com/read/2014/09/23/201100027/Melihat.Cara.Pembuatan.Arak.Bali.di.Karangasem>

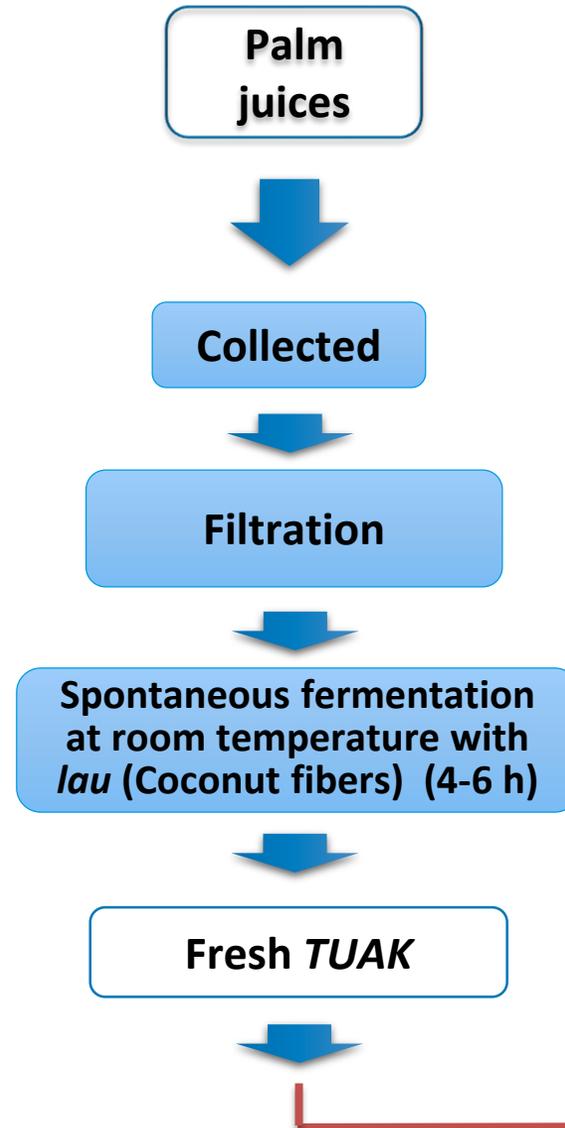
4.4 TUAQ (Fermented palm juices)



<https://www.twgram.me/tag/tuakmanislegenda/>



<https://denpasarkota.go.id/baca-datang-kunjungi/149/Obat-Diabetes-Alamikoma-Coba-Tuak-Jaka-Manis>



<https://bali.antaranews.com/berita/129654/tuak-manis-dari-desa-munduk-bestala-buleleng>

Fig. 4.11 Tuak production

Conclusion



- Their vulnerability to climate change requires adaptation strategies for irrigation and cultivars selection.
- The recent forms of agricultural policy in Indonesia, which include the deployment and implementation of environmentally friendly technologies such as the SRI system, with the aim to reduce the use of chemicals.
- The **Subak** irrigation system still able to maintain the existence of agricultural water and environmental sustainability.
- The Indonesian government should use two approaches at both ends of the chain to achieve rice self-sufficiency. On the one hand, encouraging farmers to increase their production by stimulating technological innovation and by providing subsidized fertilizer. At the other end, the government tried to curb the consumption of people's rice.
- Some of the traditional rice wine products in Indonesia such as **arak**, **brem**, and **tuak** were originally made for ceremonial, ritual symbolism and celebrations but developed into a favorite drink and even became a promising commercial product.
- Knowledge of fermentation technology, selection of raw materials, starter culture, will provide better product quality and will be a positive impact on the development of alcoholic beverage.



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Thank you very much
for your attention

<http://www.mantrahindu.com/tag/tumpek-uduh/>