

# Geographical Distribution of Glutinous Rice in the Greater Mekong Sub-region

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## Abstract

Glutinous rice, also known as sticky rice, is not only a staple food, it is also integral to the food security of small household farmers in the Greater Mekong Sub-region (GMS), and the traditional favorite variety in the rice bowl of ASEAN. The goals of the present study were to seek more information about glutinous rice, especially its geographical distribution, and create a glutinous rice map based on the germplasm accession data of glutinous rice varieties conserved in the International Rice Genebank (IRGC). The study found that glutinous rice is found on five continents: Asia, South America, North America, Europe and Africa. As of November 2013, 6,530 glutinous rice varieties had been collected for preservation at the IRGC. The continent from which the highest number of samples was collected is Asia, (6,484 varieties) of which 4,802 came from the GMS. The Tai ethnic groups in the GMS and especially in the Lao PDR, Thailand, and Vietnam are the main growers of glutinous rice. Within the GMS, the largest collection is from Lao PDR (2,470 varieties), followed by Thailand (1,289 varieties) and then by China (374 varieties).

**Key words:** Glutinous rice, sticky rice, geography, map, Greater Mekong Sub-region

## บทคัดย่อ

ข้าวเหนียวมีความสำคัญต่อเกษตรกรในอนุภูมิภาคลุ่มน้ำโขงในด้านความมั่นคงทางอาหารและอาชีพ ข้าวเหนียวมีความผูกพันกับขนบธรรมเนียมวัฒนธรรมของชาวอาเซียนโดยเฉพาะในแถบลุ่มน้ำโขง ซึ่งเปรียบเสมือนเป็นอู่ข้าวอาเซียน การศึกษานี้มีวัตถุประสงค์เพื่อการรวบรวมข้อมูลเกี่ยวกับข้าวเหนียวในพื้นที่ลุ่มน้ำโขงโดยเฉพาะอย่างยิ่งการกระจายพันธุ์ข้าวเหนียว เพื่อนำมาสร้างแผนที่การกระจายพันธุ์ของข้าวเหนียว โดยอ้างอิงจาก

ฐานข้อมูลพันธุ์ข้าวเหนียวที่เก็บสะสมไว้ในธนาคารเชื้อพันธุ์ข้าวนานาชาติ จากการศึกษพบว่า ข้าวเหนียวถูกพบใน 5 ทวีปของโลก คือ เอเชีย อเมริกาใต้ อเมริกาเหนือ ยุโรป และแอฟริกา ในปี ค.ศ. 2013 พบว่ามีตัวอย่างพันธุ์ข้าวเหนียวเก็บรักษาไว้ ณ ธนาคารเชื้อพันธุ์ข้าวนานาชาติ จำนวน 6,530 ตัวอย่าง โดยทวีปที่มีข้าวเหนียวมากที่สุดคือ เอเชีย (6,484 ตัวอย่าง) โดยเฉพาะอย่างยิ่งในอนุภูมิภาคลุ่มน้ำโขงมีข้าวเหนียวถึง 4,802 ตัวอย่าง โดยมีกลุ่มชนเผ่าไท ในอนุภูมิภาคลุ่มน้ำโขงคือกลุ่มหลักที่เพาะปลูกข้าวเหนียวโดยเฉพาะอย่างยิ่งในประเทศลาว ไทย และเวียดนาม และพบว่าประเทศที่มีพันธุ์ข้าวเหนียวมากที่สุดในอนุภูมิภาคลุ่มน้ำโขงคือประเทศลาว (2,470 สายพันธุ์) ประเทศไทย (1,289 สายพันธุ์) และประเทศจีน (374 สายพันธุ์) ตามลำดับ

**คำสำคัญ:** ข้าวเหนียว ภูมิศาสตร์ แผนที่ อนุภูมิภาคลุ่มน้ำโขง

## Introduction

Rice is widely regarded as a staple food for people around the world, especially in Asia. Nearly 90 percent of the world's rice is produced for local consumption, with only about 10 percent for international trade in the Asia-Pacific Region. [where?]In Asia, where over 4 billion people live on rice, it is pivotal to the Asian way of life, culture, customs and traditions (Shrivastava, 2009). Asia has an annual rice harvest area of about 135 million hectares, providing part- and full-time jobs to more than 300 million people and supporting about 7 billion rice consumers worldwide (USDA, 2010; Mohanty, 2013: 44-45). Glutinous rice is an important crop in various dimensions, including food, socio-economic culture, and community security, especially for ASEAN countries. A specialty rice variety in Asia, glutinous rice is also believed to provide basic nutritional security to poor rice farmers and their families (Naivikul, 2013).

Rice is classified into different groups based on various criteria, such as source of origin, degree of photosensitivity, planting seasons, processing methods and cooking characteristics. Rice products are also classified into many different categories, based on processing and cooking methods as well as eating quality. Rice is a staple food, and is

also used in making desserts and drinks, as well as cosmetics and other products. In cultural terms, rice can be classified into ordinary rice and glutinous rice or sticky rice. However, there are only two major popular types of rice: *Oryza glaberrima*, which is grown mainly in tropical Africa and *Oryza sativa*, which is produced in Asia and other parts of the world (Naivikul, 2013). Glutinous rice, which is popularly grown in the Greater Mekong Sub-region (GMS) is a variety of *O. Sativa*, i.e. *O. Sativa var. glutinosa*, which is different from ordinary non-glutinous white rice, *O. Sativa var. indica*. Japanese sticky rice is known as *O. Sativa var. japonica* and that of Indonesia is known as *O. Sativa var. javanica*.

Rice, in general, is considered the pillar of Asian food security and the focus of agricultural and food policies; Southeast Asia is almost equated with rice. The importance of rice is based on its dominance in production, as it is a key source of income for many rural families and an important export commodity, as well as being the major staple food of the population (Sombilla, Balisacan, Antiporta, and Dikitanan, 2011: 12).

However, the importance of glutinous rice has not been given due consideration. Statistics on glutinous rice, unfortunately, are scarce and not readily available. While Thailand is known as a major rice exporter in the world, glutinous rice production accounts for about only 16 percent of total rice production and export of glutinous rice accounts for only five percent or 0.2-0.5 million metric tonnes (National Economic and Social Advisory Council, 2014: 4-9).

The GMS is an economic sub-region of Southeast Asia, consisting of the two southwestern provinces of the People's Republic of China (PRC), namely, Yunnan and Guangxi, and five mainland or northern Asia countries, namely, Myanmar, Lao PDR, Thailand, Vietnam and Cambodia. These GMS economies have in common the river basins of the Mekong River. Recent agricultural and economic development trends in the GMS region have seen a decrease in the area for growing rice because of increasing fuel (cassava) crops and economic crops. This decrease poses a direct threat to food (glutinous rice) security, especially for the less-developed communities in the GMS.

Even though glutinous rice is not an economic crop, it is a strategic crop of the GMS that more than 20 million people consume on a daily basis. There is no clear policy for developing and promoting glutinous rice production in the GMS, due to the limitation of data, which will undoubtedly affect the planning and management strategies for glutinous rice production in the future. The study of glutinous rice distribution in the GMS can partially fill the information gap on glutinous rice research for policy formulation in the future. Thus, the specific objectives of this study were to gather and analyze information on glutinous rice distribution in order to create a glutinous rice map of the GMS.

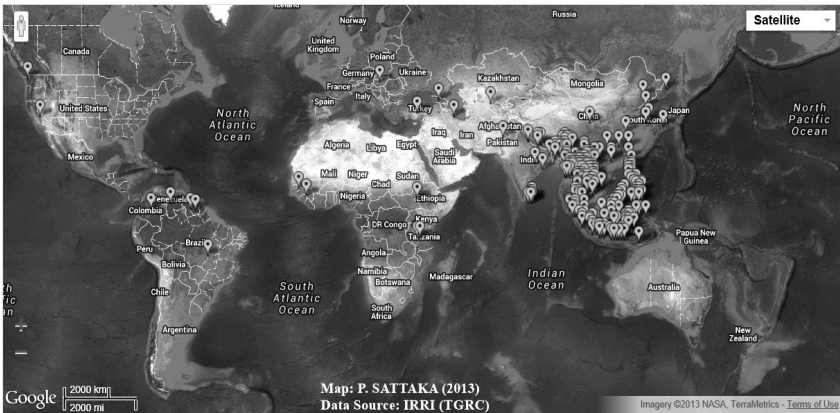
## Literature review

### *Historical and general background*

Glutinous rice is reported to have been cultivated in Southeast Asia, mainly by Tai-speaking people who migrated to the area about 1,000 to 1,500 years ago. It was found that glutinous rice is grown in the southern part of China (Yunnan province), the northeastern part of Myanmar, the northwestern part of Vietnam, the northern part of Cambodia and the northern and upper northeastern parts of Thailand. It is estimated that the glutinous rice zone covers an area of approximately 0.5 million square kilometers (Watabe, 1967; Golomb, 1976: 1-15; Falvey, 2000).

The evolutionary and geographical origins of glutinous rice are unclear. Because the glutinous phenotype is not detectable in the archaeological record, the region of its earliest cultivation has not been scientifically proven or documented. Efforts to trace its origins are further complicated by its long-standing cultural importance throughout a very wide geographical area in East Asia that includes portions of China, Japan, Korea and the countries of Southeast Asia. Lao Buddhist legend places the origin of glutinous rice at 1,100 years ago (Terwiel, 1994: 10-23). In 2014, the researchers found that glutinous rice is grown in 37 countries around the world — Lao PDR, Thailand, Indonesia,

China, the Philippines, India, Vietnam, Myanmar, Cambodia, Japan, Malaysia, South Korea, Taiwan, Nepal, Bangladesh, Srilanka, Brunei Darussalam, Brazil, the United States, Hungary, Senegal, Tanzania, Turkey, Burundi, Colombia, Ethiopia, Georgia, Guinea, Guinea Bissau, Guyana, Iran, North Korea, Pakistan, the Russian Federation, Surinam, Uzbekistan and Venezuela—as shown in Figure 1 (Sattaka, Pattaratuma, and Attawipakpaisan, 2014).



**Figure 1** Geographical distribution of glutinous rice globally

Source: Sattaka et al. (2014)

Glutinous rice has been, and still is, a part of the culture and tradition of the Mekong River-basin communities. It is consumed mainly in the GMS, especially in Lao PDR where the entire population consumes it as the main staple food. In Thailand, it is a main staple food and associated with the life of people in the upper north and northeast, the country’s lower economic regions. As such, glutinous rice consumption appears to be closely associated with the economic status of the population. Recent agricultural and economic development trends in the GMS have led to increasing competition between food (rice) and fuel (cassava) crops, posing a direct threat to future food security, especially for the less-developed communities in the GMS (Sattaka, Padakan, and Latvilayong, 2013).

### **Glutinous rice: A specialty crop in the GMS**

Glutinous rice or sticky rice (*Oryza sativa* var. *glutinosa*) is a special type of rice. In spite of its name, var. *glutinosa*, it has no gluten and so is considered a valuable, gluten-free carbohydrate. Generally, non-glutinous rice grain contains two types of starch — amylose and amylopectin, but glutinous rice has more than 90 percent amylopectin. The amylopectin plays a part in providing glutinous rice grains with their special, characteristic appearance. Raw glutinous rice grains have an opaque white color that becomes translucent after cooking, generally by steaming. Such characteristics are opposite of ordinary white rice, which is off-white and somewhat translucent as raw grain and becomes an opaque white after cooking (Table 1) (Naivikul 2013). Cooked glutinous rice grains tend to stick together as clumps, while ordinary white rice does not and appears to be fluffy.

The genetic mechanism also determines the characteristics of a rice cultivar, but environmental conditions, including agricultural practice, also play a role. For example, the air temperature during the ripening period has a considerable effect on the amylase contents, while the air humidity affects the amylopectin viscosity (Nguyễn, 2001).

**Table 1** Synoptic comparison of glutinous and non-glutinous rice

	Glutinous rice	Non-glutinous rice
Kernel shape	Round or long	Round or long
Color of grain	Opaque, chalky white	Translucent
Mode of use	Soaked before cooking	Not soaked before cooking
After cooking	Translucent	Opaque, white
Density	Low	High
Dextrin content	High	Low
Amylopectin content	High	Low
Amylose content	Low	High

Modified from: Nguyễn (2001)

Today, growing glutinous rice is still considered to be a cultural preference, not an indication of environmental variation. In the GMS, the traditional cultivation of glutinous rice covers an estimated 50 million hectares across several ethnic groups especially in Lao PDR, Thailand and Vietnam, the majority of which are of Tai origin and all of which have some Tai association (Watabe, 1967). The fact that glutinous varieties originated as a short growing-season variety suited to low rainfall regimes and light soils with minimal water control and are a recessive mutant that can only be differentiated at harvest, suggests that it was originally selected from ordinary rice varieties (Falvey, 2010:183-244). As such, glutinous rice is regarded to be much more than a commercial commodity to the people in the GMS. Nevertheless, glutinous rice has also become commercialized with limited markets, mainly in China, Indonesia and some African countries.

Thus, the importance of glutinous rice can be summed up as follows. 1) It is the staple food for Tai ethnic groups and the people in the GMS especially in Lao PDR, northern and northeastern Thailand, and northern Vietnam. 2) It is the main ingredient of snacks, desserts, beverages, pickles and cosmetics. 3) Glutinous rice is a cultural crop of the GMS from the past to the present. 4) It is a strategic food crop that provides income for GMS countries.

### ***Cultivation and consumption in GMS countries***

***Cambodia:*** Mainly non-glutinous varieties of rice are cultivated on an estimated 2.2 million hectares in the rain-fed lowlands. Rice has contributed significantly to the growth of the Cambodian economy. Farmers have cultivated thousands of varieties for many hundreds of years (Sarom, 2007: 57-58). Traditionally a great number of local varieties were used, including glutinous rice (Deichert and Koma, 2002:7). Information about glutinous rice in Cambodia is not precise. Since the country produces many rice varieties, the inhabitants prefer to consume the best aromatic grains and various types. Glutinous rice is more commonly served as a side dish, with a salad or in desserts with fruits, like mango or durian, and with coconut milk. Moreover, it is used in marriage ceremonies and in spirit and ancestor offerings.

**China:** China is the major importer of glutinous rice in the GMS although the people consume mainly non-glutinous rice. China has a long tradition of production and utilization of glutinous rice but there is no clear production data. Glutinous rice is believed to have been used to strengthen the mortar in the construction of the Great Wall of China, where archaeological evidence shows that such mortar was in use perhaps as many as 1,600 years ago (Yang, Zhang, Pan, and Zeng, 2009: 1641-1647). While glutinous rice is consumed widely in China as a delicacy, it is cultivated in the southern (GMS) provinces of Guangxi and Yunnan, where the Tai people still live.

**Myanmar:** Glutinous rice in Myanmar is associated with Tai ethnic group, their similarities in rice cultivation system and consumption of glutinous rice especially in the northern river valleys across to Myanmar (Falvey, 2010:183-244). Although non-glutinous rice is the main cereal consumed and cultivated by the Burmese, glutinous rice is the one of important ingredients of snacks and desserts. Glutinous rice is called “*kao hnyin*” and it is very popular in Myanmar especially during the *htamane* (rice) cooking festival, which is a traditional event that occurs in late January or early February.

**Lao PDR:** Researchers believe that local people began cultivating glutinous rice 6,000 years ago. This nation has the largest numbers of local producers and consumers of glutinous rice, who account for about 85 percent of its rice production. Glutinous rice is grown and consumed extensively in Lao PDR, with an annual production of about 2.66 million metric tonnes. However, the country has also imported glutinous rice from neighboring countries for consumption. Lao people have a particularly strong cultural affinity for glutinous rice, such as a saying that if they did not eat glutinous rice they would not be Lao (Schiller, Appo Rao, Inthapanya, and Hatsadong, 2006; Swiss Agency for Development and Cooperation, 2007: 7).

**Thailand:** Glutinous rice is known as “*khao niao*.” The local wisdom of producing and consuming glutinous rice has long been part of Thai society. Thai farmers grow both non-glutinous and glutinous rice and the latter is mainly for local consumption to meet their own



staple food requirements. Moreover, Thailand is the largest glutinous rice exporter with an export value of more than 5,100 million baht (Phawapinit, 2011). The Ministry of Agriculture and Cooperatives in 2014 reported that the total glutinous rice growing area consisted of 3.1 million hectares (30.7 percent). Production is largely confined to 2.5 million hectares (25.1 percent of the national area under glutinous rice) in the northeast, 0.56 million hectares (5.5 percent) in the north, only 6,061.12 hectares (0.06 percent) in the central region and a mere 108.32 hectares (0.001 percent) in the south (Ministry of Agriculture and Cooperatives, 2014). Glutinous rice, namely “*khao nueng*” or steam-cooked glutinous rice, a staple food for people in the north northeast, has become a popular delicacy for people throughout the country.

**Vietnam:** In Vietnam, growing sticky rice is a long-standing tradition. However, in recent times, local inbred sticky rice varieties, such as Ga Gay and Hoa Vang have been replaced by hybrid varieties, e.g. N97, N98 and ĐN 20. Even though glutinous rice is not a staple food like in Lao PDR where it is eaten at every meal, it still is indispensable in Vietnam for its unique taste and aroma. Glutinous rice also accounts for 10 percent of total rice production and about 10 percent of rice consumed by Vietnamese (Trudel, 2012). Glutinous rice is called “*gạo nếp*”. Dishes made from glutinous rice in Vietnam are typically served as desserts or side dishes, but some can be served as main dishes such as *bánh chưng*, *xôi*, *cơm lam*, etc. Moreover, Nguyễn (2001) reports that glutinous rice is used in all festivities, from weddings to funerals, from ancestor worship to rituals and folk festivals at various levels.

## Methodology

The study was based on the global collection of rice germplasms maintained at the IRGC of the International Rice Research Institute (IRRI) located in Los Baños, Laguna in the Philippines. The study was conducted during November 2013 - May 2014. Data collection and information analysis consisted of the following.

1. An information search on sources of germplasm collection was made by accessing the IRGC Collection Information System (IRGCIS).
2. Major keywords needed to search for specific information were countries, endosperm type (glutinous), latitude and longitude.
3. Search results were compiled and ranked, based on the number of varieties collected from each country of source. Data were analyzed specifically for Asia and the GMS, respectively.
4. After separating the glutinous rice data by countries and continents, the data was checked for verification and the latitudes and longitudes of glutinous rice varieties were determined for use in creating maps the using the Batchgeo free software program (Batchgeo, 2013).

## Results and discussion

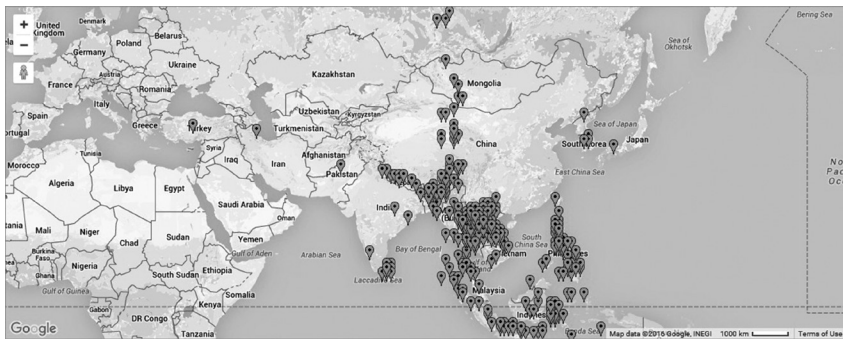
### *Geographical distribution of glutinous rice: General overview*

As of November 2013, there were over 210,000 entries of rice varietal samples conserved in the Rice Gene Bank at IRRI, which is the largest collection in the world.

The initial study and screening of the entire gene bank collection data at IRRI was to determine the number and frequency of glutinous rice varieties by country in the total collection. It was found that glutinous rice samples comprise only about 3.7 percent or 6,530 samples of the total collection. In terms of geographical distribution, those samples were collected from five continents around the world, namely, Asia (Figure 2), Europe, Africa, South America and North America, indicating that glutinous rice is, in general, distributed more or less throughout the world (Table 2). As expected, the continent from which the majority of glutinous rice varietal samples were collected for conservation at IRRI was Asia, with 6,484 varieties or over 99 percent, particularly Lao PDR (2,470 varieties), Thailand (1,289 varieties) and Indonesia (529 varieties), respectively.

**Table 2** Number of glutinous rice varieties in each continent collected in the IRGC

Ranking	Source	Number
	Globally	6,530
1	Asia	6,484
2	South America	16
3	North America	12
4	Europe	3
5	Africa	7



**Figure 2** Geographical distribution of glutinous rice in Asia

Source: IRGC (2013)

***Glutinous rice distribution in the GMS***

The study found 4,802 glutinous rice varieties in the International Rice Genebank from the countries in the GMS, as follows: Cambodia (180 varieties), China (374 varieties), Lao PDR (2,470 varieties), Myanmar (216 varieties), Thailand (1,289 varieties), and Vietnam (273 varieties).

As mentioned earlier, glutinous rice is unique in its origin and distribution, both of which are mainly in the GMS area. It is also unique in its taste, consumption and utilization, much of which is culturally related. As such, it can serve as a geographically specific ‘trade mark’ of the GMS region. Among the countries of the GMS region (Figure 3) in terms of geographical distribution, Lao PDR is the most significant

producer and consumer of glutinous rice, because its people grow and consume glutinous rice in all regions by using various local and breeding varieties. Most of the Laotian population of about 6 million living throughout the country grow and consume glutinous rice as their staple food. In Thailand, glutinous rice is also consumed as a staple food in the northern and northeastern regions of the country, covering approximately 30 million people (Sattaka et al. 2013). Thailand is the most important exporter of glutinous rice to consumers in the world to places such as Japan, China, Philippines, Taiwan, Indonesia, and the US (Phawapinit, 2011).

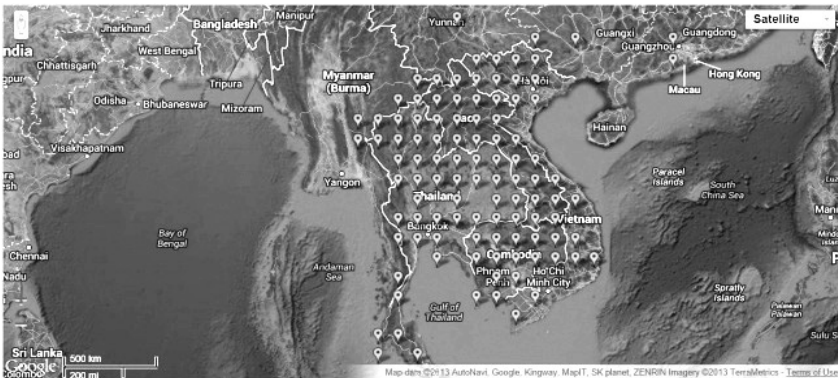


Figure 3 Geographical distribution of glutinous rice in the GMS region

### ***Glutinous rice in Cambodia***

Cambodia grows both glutinous rice and non-glutinous rice in four main ecosystems — the rain-fed lowland ecosystem (84 percent of the total rice cultivated area of 2.80 million tonnes), the dry season (irrigated and recession; 12 percent) and the upland and deepwater (each with 2 percent). Cambodians use glutinous rice mainly for making snacks and desserts, such as cakes and glutinous rice roasted in bamboo, and people near the borders with Lao PDR and Thailand use it as cooked rice for food. Moreover glutinous rice is used for ritual ceremonies such as in the Ploughing Ceremony and offerings to deities and spirits. In 2011 glutinous rice made up 8.4 percent of the rice accessions

conserved in the gene bank at CARDI (Ouk and Sakhan, 2010: 2; Vang, 2011).

In Cambodia, glutinous rice varieties are found throughout the country (Figure 4). In 1998, there were 65 glutinous rice varieties in the IRGC (Nguyễn, 2001), while the current study found 180 glutinous rice varieties in 2013. Only 36 glutinous rice varieties out of the 180 are resistant to Blast, and 8, 8 and 2 varieties are resistant to Tungro virus, Sheath blight and Bacterial blight, respectively.



Figure 4 Geographical distribution of glutinous rice in Cambodia

**Glutinous rice in China**

In China, glutinous rice distribution appears to have been culturally influenced and closely associated with the early southward migration and distribution of the Tai ethnic group along the Mekong River basin, originating from southwestern China. Thus, glutinous rice is grown mostly in the south of China, especially in Guangxi province as one part of the GMS (Figure 5). In 1998, 297 varieties were recorded in the IRGC (Nguyễn, 2001), whereas the current study found that in 2013, there were 374 varieties. Only 3 glutinous rice varieties of the 374 varieties are tolerant to alkali, while 6 varieties are tolerant to flooding. Moreover, 27, 34, and 7 varieties are resistant to blast, tungro virus and bacterial blight, respectively, and only one variety is resistant to sheath blight.

Tang, Li, and Bonjean (2010) reported that rice is the most ancient food crop in China, with a long history of cultivation. In ancient times, *japonica* rice was called *keng* or *jing*, *indica* rice was called *hsien* or *xian*, and glutinous (waxy) rice was called *nuodao*. Based on 2007 statistical data, *indica* and *japonica* rice were planted on 21.63 and 7.31 million ha, respectively. There were also 0.29 million ha planted with glutinous rice (Tang, Li, and Bonjean, 2010: 15-34).

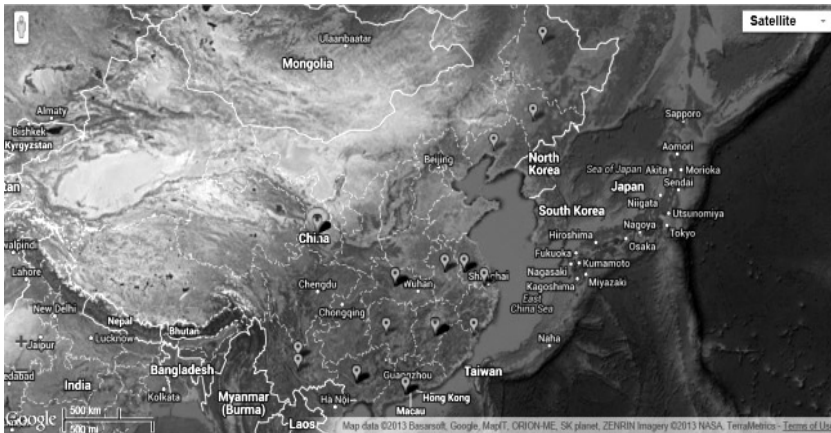
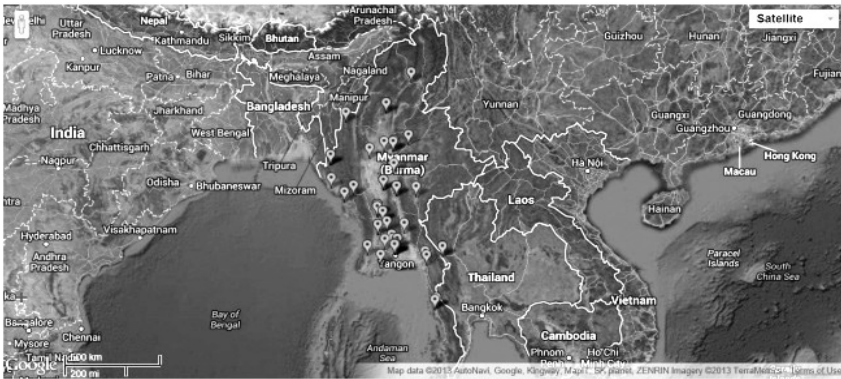


Figure 5 Geographical distribution of glutinous rice in China

### ***Glutinous rice in Myanmar***

Rice productivity in Myanmar has stagnated compared to other rice producers in the region. Once the world's largest rice exporter, Myanmar is now a relatively minor exporter with an average of 631,000 million tonnes annually (Denning, Baroang, and Sandar, 2013: 3). The major rice producing areas are in the delta, in the Ayeyarwady, Bago, Yangon and Mon states, with the Ayeyarwady region recognized as the "Rice Bowl of Myanmar." At present, the rice production area is increasing to 7.0 million hectares from 6.5 million hectares in 2013-2014. Even though non-glutinous rice is the staple food in Myanmar, glutinous rice is important as well, especially in region bordering Lao PDR and Myanmar, where it is consumed as a staple food. Moreover, glutinous

rice is popular during the traditional *Htamane* Festival. Figure 6 shows that the most glutinous rice varieties are found in central and north Myanmar, particularly in the Ayeyarwady delta. In 1998, there were 134 glutinous rice varieties in the IRGC (Nguyễn, 2001), while the current study found 216 varieties in 2013. Of the varieties from Myanmar, only two out of the 216 are resistant to blast, while 55, 2 and 1 variety are resistant to tungro virus, bacterial blight and sheath blight, respectively.

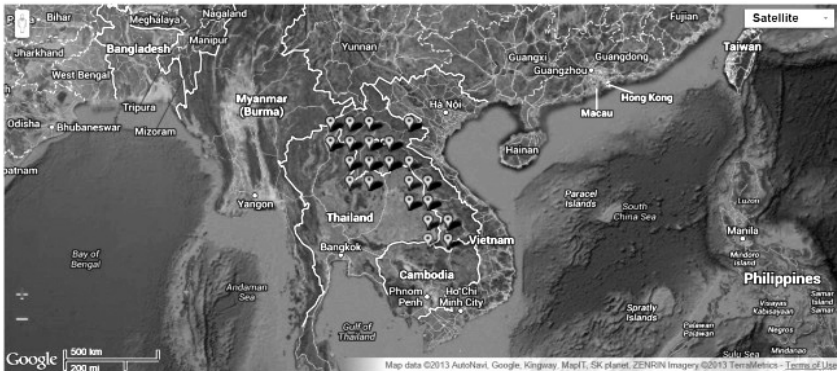


**Figure 6** Geographical distribution of glutinous rice in Myanmar

### ***Glutinous rice in Lao PDR***

Given the fact that glutinous rice is grown extensively in Lao PDR, it is not surprising that varieties are planted throughout the country (Figure 7). In 1998, there were 664 glutinous rice varieties in the IRGC (Nguyễn, 2001), whereas the current study found that there were 2,470 in 2013. Only four glutinous rice varieties from the 2,470 varieties are tolerant to alkali, while six, five and four varieties are tolerant to cold, flooding and salt, respectively. The study indicated that 374, 365, 22 and 15 varieties are resistant to blast, tungro virus, sheath blight and bacterial blight, respectively. Moreover, the study showed that some of these glutinous rice varieties are in Thailand. Although Thailand and Lao PDR are separated by the Mekong River, cross-border migration may have resulted in some varieties being grown in Thailand.

Schiller et al. (2006) reported that Lao PDR and its people also have a particularly strong cultural affinity for glutinous rice. Differences exist between regions and between production systems in the relative significance of glutinous rice production. These differences are reflected in a combination of regional differences in the ethnic composition of the population and related to differing rice consumption preferences. Moreover, among the GMS member countries, Lao PDR contributed the most in terms of rice genetic resources to the world at large, through the repository of its rice germplasm in the IRRI International Rice Gene Bank. Lao PDR is also the center of the glutinous rice consumption zone in the GMS (Latvilayvong, Sattaka, Sangduen, Padakan, and Suwana-adth, 2010).



**Figure 7** Geographical distribution of glutinous rice in Lao PDR

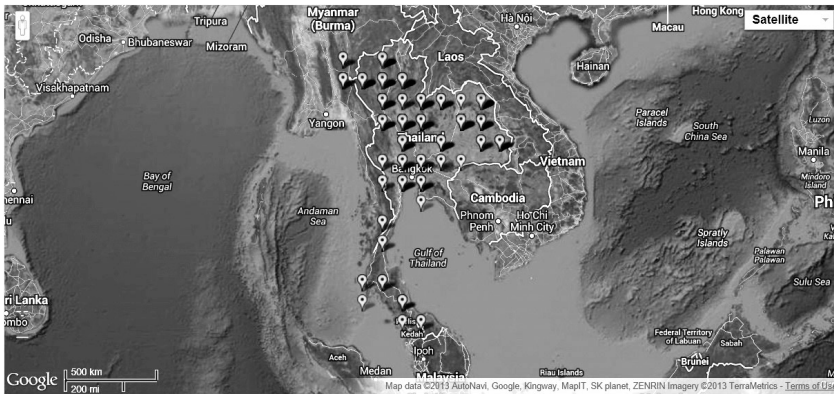
### ***Glutinous rice in Thailand***

In Thailand a common saying of the Thai people is that “there are fish in the water and there is rice in the field,” which reflects how important rice is as food for Thais. Glutinous rice is grown in every part of the country, especially in the northeast (Figure 8). In 1998, there were 1,251 varieties in the IRGC (Nguyen, 2001), while the current study found that in 2013 there were 1,289. Only four varieties from the 1,289 varieties are tolerant to alkali, while 1, 41 and 12 varieties are tolerant



to cold, flooding, and salt, respectively. Moreover, 236, 101, 19 and 2 varieties are resistant to blast, tungro virus, bacterial blight and sheath blight, respectively. Moreover, the study found that there were 335 varieties of glutinous rice in the Rice Genebank in Thailand in 2009.

Thai researchers reported that glutinous rice is an important crop for consumption and is deeply associated with Thai culture and tradition. Moreover, it is also important in terms of food security for small-farm holders in northeastern Thailand. They found that 27.52 percent of farmers preferred planting glutinous rice of all the rice cultivated areas in the wet season. Annual average production of glutinous rice was around 4 million tonnes of milled rice or about 17.5 percent of total production. Increasingly, globalization and industrial investment promotion have alarmingly reduced the area of farmland, threatening the livelihood of glutinous rice farmers. However, glutinous rice production emphasizes household consumption while only the remaining products are sold (Srisompun, Kao-int, Khongritti and Songsrirod, 2013: 26-34; Isvilanonda, 2013).



**Figure 8** Geographical distribution of glutinous rice in Thailand

***Glutinous rice in Vietnam***

Vietnam primarily has a rice-based, agricultural economy, with most of the rice grown in the two rich deltas of the Mekong River in the south and the Red River in the north. The harvested area of rough rice was

7.414 million hectares, with rough rice production of 38.725 million tonnes and a rough rice yield of 5.22 tonnes per hectare (IRRI, 2010). More than 10 percent of the total area is used for growing glutinous rice only, located mostly on and near the Mekong River and in the Red Triangle Delta. Nevertheless, Figure 9 shows that glutinous rice varieties in Vietnam are geographically concentrated mainly in the north and south of Vietnam, and are important for rice cultivation. Furthermore, glutinous rice varieties are also planted in the center of Vietnam. In 1998, there were 142 varieties in the IRGC (Nguyễn, 2001), while the current study found 273 glutinous rice varieties in 2013. Only 15 glutinous rice varieties from the 273 varieties are tolerant to cold and only one variety was tolerant to flooding. Moreover, 63, 51, 9 and 3 varieties are resistant to blast, tungro virus, sheath blight and bacterial blight, respectively.

Nguyễn reported that most Vietnamese, in the past as well as at present, consider their wealth is complete if they are full of non-glutinous rice and glutinous rice. [do you mean if they have enough non-glutinous and glutinous to eat? Yes] Even though the majority of Vietnamese consume non-glutinous rice as a staple food at the present, glutinous rice is one of the staple food crops of ethnic groups in northern Vietnam. The Vietnamese believe that glutinous rice is more nutritious and more aromatic than other kinds of rice (Nguyễn, 2001).

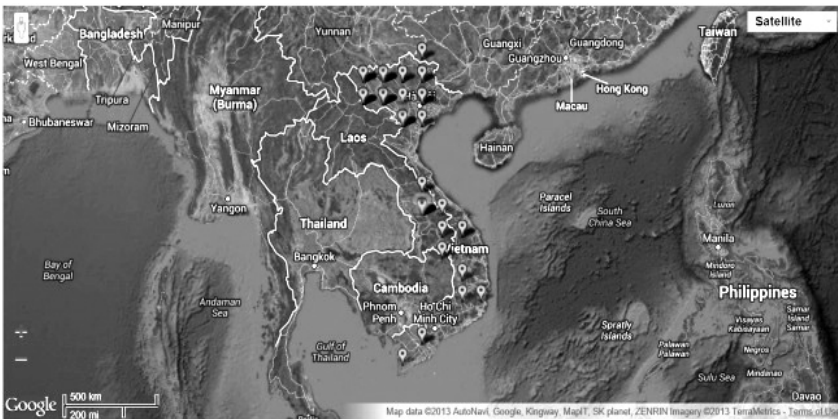


Figure 9 Geographical distribution of glutinous rice in Vietnam

## **Summary and concluding remarks**

1. Glutinous rice is a strategic food crop of the GMS that is relevant to food security and that provides income for local farmers and GMS countries. Glutinous rice is much more than just food as it is the people's traditional and cultural preference; it is also associated with the Tai ethnic group who migrated from China to the GMS countries.

2. About 37 countries from five continents in the world have grown glutinous rice, based on the collection in the IRGC and 6,530 varieties have been collected. The three major countries which have contributed to the glutinous rice collection are Lao PDR (2,470 varieties), Thailand (1,289 varieties) and Indonesia (529 varieties).

3. Within the GMS region, 4,802 glutinous rice varieties are stored in the IRGC, having been sourced from: Lao PDR (2,470 varieties), Thailand (1,289 varieties), China (374 varieties), Vietnam (273 varieties), Myanmar (216 varieties) and Cambodia (180 varieties). This indicates that glutinous rice is a geographical indicator of the GMS region. It is unique in its origin and distribution, and is very much culturally related to the GMS. Thus, glutinous rice communities that are unique in traditional and cultural dimensions and are famous for their glutinous rice products should be systematically encouraged as a network of tourism destinations in the glutinous rice corridor.

4. Rapid economic growth and climate change in the region are important factors in the decrease of glutinous rice growing areas. The recent food crisis enabled agriculture to receive the attention it had long been seeking and stimulated a rethinking of the pursuit of self-sufficiency, especially for rice. Hence, the GMS countries developed rice policies focusing on increasing productivity for food and cultural security.

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