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Indigenous Knowledge for *Khao Hom Mali* Rice Production and Development for Export in the *Thung Kula Rong Hai* Plain

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Abstract: *Thung Kula Rong Hai* Plain is a vast open area located in the center of Northeast Thailand. It is Thailand's most important source of growing *Khao Hom Mali* Rice, which is famously known worldwide as Thai Fragrant Rice or Thai Jasmin Rice. The rice production in general was dependent on the amount of rainfall. Indigenous knowledge was applied to adapt to the situation by dividing rice planting areas into three zones or paddies in which different strains of rice were grown according to the amount of water levels that the 3 areas could sustain. The selected rice strains were *Khao Bao* or Light rice, *Khao Klang* or Medium rice and the last is *Khao Nuek* or Heavy rice. The harvest was mostly consumed within the family with small amounts put aside for trade and seedlings. In 1974 the government promoted the production of *Khao Hom Mali* Rice strain 105 for mass commerce which increasde harvest and provided more income. Farmers, government offices and private sectors had to adjust to new market conditions and adapt new technologies and innovations to keep up with market demand. Mass production and chemicals caused widespread soil destruction and loss of traditional farming methods. New guidelines and studies from private and government sources were implemented and applied to farming communities to preserve the quality of rice, farm land and lifestyle. The Integration of Indigenous Knowledge and modern techniques proved successful, which has resulted in quality *Khao Hom Mali* rice, which is safe for consumers worldwide.

Key words: Indigenous knowledge, *Khao Hom Mali* 105, *Thung Kula Ronghai*, Northeast Thailand, agricuture development, rice production, rice commerce

INTRODUCTION

Thailand is the world's largest exporter of rice. In 2007, 28.82% of global rice exports came from Thailand which amounts to 8.5 million tons of rice. *Thung Kula Rong Hai* is a vast plain located in the center of Northeast Thailand. It currently is the most prosperous production zone for growing *Khao Hom Mali* Rice or Thai Fragrant Rice or Thai Jasmine Rice which is famous worldwide. The Plain is a vast grassy prairie with small sand dunes, minimal trees and resembles a savannah with tall grass (Khanarsa, 1978). Before 1972, the area was sparsely populated. Economic hardships in the surrounding communities forced many families to search for land, which could provide shelter and a source of viable income. Therefore, people started to migrate into the vast grassy plain and started planting rice. Traveling between villages was made possible only by trails, which went around the vast fields of grass and swamp. Navigation was made possible by planting trees as markers along trails so that villagers wouldn't get lost. Villagers soon preempted into the grasslands by force and self proclaim land that was available. Relatives were later contacted and then entire families and extended families migrated in large groups until the area turned into a large agricultural community. Each family's territory was marked by wooden posts or earthen dykes and ridges to mark their paddies and fields. This eventually evolved into land purchase by trade or direct cash. The central government eventually issued land rights to the villagers claim.

MATERIALS AND METHODS

Area of the study: This research applied cultural Qualitative Research methods. Data was collected in *Thung Kula Rong Hai* plain, which included 12 villages in

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the District of Kasetwisai and Suwannapum in Roi-et Province located in Northeast Thailand. The main purpose of this research was to identify and preserve local Indigenous Knowledge of local farmers in *Thung Kula Rong Hai* plain and the development of *Khao Hom Mali* Rice production. Data collection included interviews, observations, group discussions and seminar workshops and document analysis. Research data was classified into groups on study topic and analyzed on the purposes of study by using descriptive analysis. Informants included 24 key informants that have indebt knowledge of rice production and are directly involved in agriculture harvest and research. Total 83 casual informants were local farmers and leaders from communities and from rice export organizations and agricultural institutions. Data from 43 general informants were collected from rice resellers, consumers and individuals with occupations related to *Khao Hom Mali* Rice production and commerce in private and government sectors.

RESULTS AND DISCUSSION

Traditional indigenous knowledge in the production of *Khao Hom Mali* Rice: The growing of *Khao Hom Mali* Rice in *Thung Kula Rong Hai* in the past was primarily for personal consumption within the family. Small amounts were put aside for small trades and for seedlings in next season's harvest. There was no industry or large scale commercial production of rice crops at the time. Local name of the strains of rice grown were mainly divided to 2 categories. *Khao Jao* which is a rice strain belonging to the family Oryza Sativa Linn and *Khao Niew* or Sticky Rice or Glutinous rice were the most popular strains. *Khao Jao* and *Khao Niew* had many varieties and called locally by many names. Local names include *Khao Jao Pan Dok Kayom*, *Khao Hang Ma Jog, Khao Jao Pom,* etc. Local Sticky Rice grains included *Khao Niew Pan Mak Muay, Khao Pong Aew, Khao San Pa tong*, etc.

Selecting the appropriate land: Past and present farmers relied primarily on the annual rainfall. Therefore, the selection of land for growing rice had to match to the strains of rice and the amount of water each of area or fields could hold. Three methods or methodology proved successful in providing a good harvest. *Khao Bao* or *Kao Daw* or light rice was grown in elevated or hilly fields were water supply was limited. The hilly rice patties would be called *Na Non or Na Don*. *Khao Klang* or Medium rice would be grown in elevated areas, where there was more water called *Na Klang*. *Khao Nuk* or Heavy rice would be grown in *Na Loom* or rice patties that were capable of containing stable and large amounts of rainfall. Annual rains would being in May and farmers would prepare the three rice strains and rice paddies. The level of rainfall in each of the rice patties would vary. Na Don or Hilly rice patties would be the first to dry out in October. Excess water would then be drained to *Na Loom* where heavy rice was grown. Planting preparations and procedures in each of the rice patties would not lapse each other and farmers were able to allocated resources from each of rice patties efficiently because the rice crops were ready to harvest at different periods. There was no rush in the harvest and family members and friends contributed to the labor. *Khao Na Don* would be planted in May and harvested in early October. *Khao Na Glang* would be harvested in December while *Kao Na Lum* would be planted in June and harvest in January-February.

Maintaining the quality of local rice strains: Local rice strains in *Thung Kula Rong Hai* have high immunity to natural diseases. Only natural fertilizers from natural resources were used such as compost and manure. Routine checks of the harvest include simple rice patty dyke checks, repairs and irrigation maintenance. Pests and weeds were manually removed or plowed over. If there were areas where plants and crops were not green and fertile then fertilizers would be manually applied to that specific area. Weeds would be prevented by plowing the soil over 1 month prior to planting. Unhealthy rice crops would be replaced with new rice sprouts to make sure the harvest would be full yield. Rats, crabs, worms and shellfish were handled by using different methods. Crabs would be removed by placing earthen pot traps in the soil by using worms or water buffalo hides as bait. The crabs would later be collected and transformed into meals. Fish and crabs were also trapped by using *Sai* or fresh water fish traps. Other techniques include the use of grinded *Yah Nuad Maew* grass (Orthosiphon Aristatus Mig) which was dissolve in the paddy waters which poison the crabs and make them disoriented. Worms and caterpillars would be exterminated by using giant red ants which eat them the worms. Rats would be manually removed or trapped and consumed as food by the use of fire and smoke. Shellfish would be manually removed, gathered the consumed.

Harvesting: Harvesting rice crops was not hurried because each types of paddies would ripen at different periods. Crops would be harvested manually using the *Kiew* or scythe. *Khao Dow* or *Khao Bao* would be harvested during September and October. While, *Khao Klang* would be harvested in November-December. *Khao Nuhk* which has the longest period of growth would finally be harvested in January and February.

Family members would all contribute to the labor. Friends and neighbors would pitch in if needed. No labor had to be hired, but food and necessities for the harvest would be provided. Harvested rice would be bundled and transported to flattened areas where the earth was cleared and paved with fresh buffalo manure and dried for 2-3 days. Finally, the dried bundles would be tied together and beaten with wooden paddles and sticks until the rice husks or un-milled rice separated from the stock. Animals such as cows and water buffalos were also used to step on the bundles to separate the husk. Un-milled rice would be collected and measured by using wooden buckets. And 1 bucket equals to about 10 kg and 36 barrels would equal 1 *Kwien* or wagon. Harvest would average about 80 kg per *Rai* or 1,600 m^2.

Storage: Un-milled rice would be stored in elevated store houses called *Lao Khao. Lao Khao* storage houses are built on stilts and the walls made from weaved bamboo or willow trees on all 4 sides. Animal manure or buffalo dung would then be mixed with water and plastered on both sides of the walls, which will prevent pests and insects from destroying the crop. The un-milled rice would be dried again before final storage. Then the *Lao Khao* storage house would be sealed until the rice is needed for consumption.

Tools and equipment: Indigenous methods of rice production required locally crafted tools and equipment of wood and metal. These tools were also used in daily household chores and also in the gardens surrounding the household. Water buffalos and cows were the primary source of plowing energy. Every farming village and households had their own personal herd of buffalos to power plows, provide manure and for making compost.

Conservation and Preservation of local rice types: It is popular belief that local rice strains must be rotated annually to prevent disease which keeps the strains healthy. Local rice strains in the past were immune to many natural diseases and can be used in many traditional foods and products. Sticky rice can be used to make *Khao Pun* or sticky rice noodles. Other local strains were used to make cakes and bakery during local festivals and celebrations.

Production of *Khao Hom Mali* strain 105

Transition to *Khao Hom Mali* strain 105 and modern rice strains: Rice production in *Thung Kula Rong Hai* is mainly for commerce. Excess produce would only be used for consumption and trade. The transition to modern rice strains and to *Khao Hom Mali* 105 started in 1974 when the government introduced *Khao Hom Mali* 105 and *Gaw Kow* 15 and 6 rice strains to local communities. Chemical fertilizers and chemical pesticides were also introduced free of charge as a pilot project to promote the growing of *Khao Hom Mali* 105. The free samples were offered to farmers with recommendations and guidelines to follow. The first harvest was higher in volume, tasted better and was more fragrant then the local rice strains. The most important was that *Khao Hom Mali* Rice was in demand by the markets and started *Thung Kula Rong Hai's* commercial rice exports. Farmers soon shifted to growing more and more *Khao Hom Mali* 105. Local rice strains were still grown but were only harvested in small quantities for personal consumption only. More and more farmers changed to favor only *Khao Hom Mali* 105 and stopped growing local rice strains. Factors contributed to the vanishing of local rice strains such as problems in controlling and exterminating pests. Local rice strains were largely destroyed by rats and insects, while *Khao Hom Mali* 105 was more resistance because of the use of chemical pesticides. The popularity of *Khao Hom Mali* 105 limited the amount of seedlings and sprouts of local rice strains. But the most significant factor was that local rice strains were not in market demand.

Modern technology and innovation: Farmers adapted and accepted the new technologies and innovations when changing to *Khao Hom Mali* 105. Delivery schedule, high volume and expansion were only made possible by the use of modern machinery and hired labor. Convenience and labor costs were the primary driving force behind the alteration. Chemical fertilizers and pesticides were chosen because of the effectiveness in exterminating pests and guaranteeing a high capacity of crops.

Development of *Khao Hom Mali* 105 for export: An area of 1.4 million *Rai* was suitable for growing rice. But flooding, drought and neglect had caused the soil became degraded, acidic and lacked nutrients. More and more areas transformed into sand. Natural water sources and water levels declined. Land that was still viable for agriculture was solitary used for growing rice crops which yielded very low amounts rice averaging only 10-15 wooden buckets of rice or about 100-150 kg per *Rai* (The Ministry of Agriculture and Cooperatives, 2000). In 1982, The Department of Land Development and The Australian Government cooperated together on a land remodeling project. Geographical Information Systems (GIS) was applied to study the Topology in *Thung Kula Rong Hai* and has established that the area most suitable for *Khao Hom Mali* Rice in Northeast Thailand is in the Province of Roi-et (The Ministry of Agricultural and Cooperatives, 2006).

Government and Private organizations and individual researchers have continuously contributed to the development for sustaining and improving the quality of rice and land in Northeast Thailand. The important factors of rice production is a combination of land, labor, production, innovations and commerce, therefore farmers should integrate Indigenous Knowledge and modern technology and innovative techniques that will provide an abundance of harvest. Government offices and organizations have stepped up efforts to promote and provide training. Farmers that participated in the training and development of *Khao Hom Mali* 105 during 2006-2007 were capable of increasing the harvest to 405.28 kg *Rai*[2]. Farmers also gained important knowledge for growing rice which they were able to apply and adapt to their harvest. Seed selection, soil preparation, selecting healthy rice strains, fertilizer utilization, natural enemies, use of pesticides, removing foreign strains of rice during growing stage, maturing stage, nourishment during maturing stage, harvest period and off season harvesting (Chaowtrakul, 2006).

In assessing soil richness from the sample of 48 plots, the soil analysis revealed that the level of soil saltiness was low and did not effect the growth of rice stalks and production of rice. Potassium and nitrogen were at medium level while pH of the soil was at the level which did not affect the growth and stipulation of rice plants. The quality of fragrance, softness, whiteness, stickiness and shininess depended on low percentage of nitrogen in the soil. To get high quality of *Khao Hom Mali* Rice products, low nitrogen soil was suitable for planting (Suwannasut *et al*., 1996). The aromatic characteristics of *Khao Hom Mali* Fragrant rice is influenced by the amount Acetyl-1-Pyrroline of 0.1-1.2 μg, which is constant throughout *Thung Kula Rong Hai* and that the different amount of harvest was due to different agricultural practices in each area (Yoshihashi, 2004).

Good Agriculture Practice GAP: Chemicals used must be approved and licit by the Ministry of Agriculture and Cooperatives. Poisons and toxic chemicals are forbidden as outlined by the legislature of Harmful Substances of 1992. The chemicals used must also be approved by foreign trade partners. Harvests must not contain over 5% of foreign strains. Rice seedlings must come from standard seeds from the Ministry of Agriculture or from credible sources that have been approved or appointed by government offices. If farmers prefer to use their own seedlings, they must come from sources that are healthy and can provide a growth rate of more than 80%. Natural fertilizers such as water buffalo and cow manure are supported and should be applied in the amount of 500-1000 kg per *Rai*. Foreign rice strains are to be removed during rice seed flowering. Harvest of the rice crops are to begin only when 75% of rice stocks have yellowed and when the rice seedlings start to lop down. Or when the rice seeds have matured 28 days after 80% of the harvest have ripened. Rice bundles are to be dried in full sunlight for 2-3 days and 1-2 days more after rice husks have been removed from the stock. During drying periods the bundles are to be overturned 4-5 times day^{-1} to ensure that the level of moisture doesn't exceed 14%. Storage facilities are to be cleaned and sanitized before storing. Temperature and humidity must be constantly checked and make sure there is enough ventilation.

Ten principles to maintain high quality *Khao Hom Mali* fragrant rice: According to, The Ministry of Agricultural and Cooperatives, 2005:

- Seedlings must be certified *Khao Hom Mali* 105 from credible sources such as Rice Research Centers and Community Rice Centers.
- The soil must be sufficient and have a high level of nutrients to Insure the quality and fragrant of *Khao Hom Mali* 105.
- Adequate irrigation must be provided to ensure that water levels in paddies are within 10-70 cm during growth periods.
- Rice paddies should be located in low plains or basins with fertile soil.
- Planting by scattering rice seeds will improve the fragrance of the crops more than growing by transplanting. If transplanting rice sprouts is preferred than the seedling used must be aged between 1-1.5 months.
- Fertilizers, pesticides and nutrients such as nitrogen should be prohibited during the plants maturing stage. Weeds and foreign strains of rice should be removed before applying fertilizers.
- Harvest is to begin only when 80% of the crops have ripened. Separating un-milled rice or husks should be performed on clean pavements that have nylon nets between the un-milled rice and the earthen floor. The bundled crops must be covered during the night to prevent moisture and kept dry during rainfall.
- Storage facilities should be sanitized with adequate ventilation. Storage should not exceed 6 months to maintain the level of fragrance.
- If milling machinery is used then it must be made sure that the speed of the axle is between 1500-1800 RPM.
- Packaging bsy using vacuum containers or vacuum bags will best retain the *Khao Hom* Mali rice's aromatic fragrance.

CONCLUSION

Khoa Hom Mali 105 rice production has been successful with the integration of modern technology and commerce supported by the central government. Rice crops have multiplied bringing higher earnings to communities in *Thung Kula Rong Hai*. Currently in 2008 there exist 3 rice exporters, 9 large scale rice mills, 3 rice wholesalers, 4 rice ports and numerous small-sized mills. The farming communities participation in the development of *Khao Hom Mali* Rice production for export in *Thung Kula Ronghai* is unanimous. But this success has resulted in the vanishing of the many benefits of the local Indigenous Knowledge of the past.

Currently, farming communities mostly grow *Khao Hom Mali* 105. Local rice strains that were grown in the past are only produced in small amounts and for family consumption. Some have abandoned local rice strains all together. This has caused farmers to only rely on *Na Lum* or heavily irrigated rice paddies for their harvests. Many have transformed *Na Klang* into *Na Lum* with the support of modern irrigation systems. *Na Don* in many areas have been abandoned several farmers still use *Na Don* for growing local strains of Sticky or Glutinous rice.

Local strains that were once championed in the past for their immunity to natural diseases are in danger of becoming extinct forever. Foods that were once abundant in rice paddies are now mostly hard to find and not healthy for consuming due to the use of chemical fertilizers and pesticides. Farmers rely primarily on Government organizations and village centers for seedling and rice sprouts sources.

The use of chemical fertilizers and pesticides has depreciated and laced the ground and water sources with chemicals. Helping each other among neighbors and friends became scarce and nonexistent. Higher cost of investment was a heavy burden on farmers. Seedlings and rice sprouts had to be purchased or leased. New costs had to be allocated for chemical fertilizers, pesticides, machinery, labor and fuel. Sometimes Supply exceeded demand causing prices to plunge and many farmers became overdrawn and had to borrow money to finance their harvests.

Lao Khao or rice storage houses have changed to modern construction materials such as concrete and metal raising problems in moisture and pest problems. Technology innovations and modern machinery have limited the use of traditional tools, animal powered plows to minor maintenance of paddy dykes, ridges and simple garden tasks. Animal powered plows have been utterly replaced by tractors pushing water buffalos to the level of endangered species which has caused animal fertilizers to be scarce and high priced. Eventually farmers have turned to the purchase manufactured chemical fertilizers and pesticides.

High investment costs in fuel, machinery and labor have led to the reconsideration of the many benefits of the Local Indigenous Knowledge of traditional rice production. Public awareness of Bio safe foods and healthier diets has also influenced new innovations in rice production and harvest to favor bio safe methods and healthier substances. Private and government organizations have encouraged the use of natural fertilizers and pesticides. Nutrients are added to soils and fields by planting supplementary crops and vegetables with nitrogen and potassium nutrients such as soybeans, green beans and peanuts which would be grown in rice paddies off season and plowed up and over before the start of growing season. Water buffalo breeding projects are being initiated in local communities to produce compost, natural fertilizers. Community centers for breeding standard *Khao Hom Mali* 105 rice seedlings and sprouts are being promoted and encouraged nationwide. Scattering seedlings instead of implanting rice sprouts have provide successful harvests bearing fruit in rice crops that have a high level of fragrance. More and more farmers are successfully integrating Local Indigenous Knowledge with modern technology. This has created a positive benefit for communities throughout *Thung Kula Rong Hai*. Lower costs and higher efficiency has provided farmers with time to conduct other trades and create supplementary income. Farmers have time to participate in projects that benefit their villages and environment. Local Indigenous Knowledge in traditional farming also adds more nutrients to the soil than by implanting rice sprouts and the use of natural fertilizers and bio safe pesticides can sustain fish, crabs and shellfish in rice paddies providing more food options (Yodmalee, 1999).

SUGGESTION AND RECOMMENDATIONS

Farmers should supplement earnings and utilize the rice patties to grow additional crops for consumption and commerce in between harvest seasons. Ponds and irrigation canals should be created and maintained as preventive measures against droughts and also for raising fish for food and extra income. Farmers should use only standard and healthy seedlings and rotate sources of *Khao Hom Mali* 105 seedlings every 3 years. Animal fertilizers should be applied to the rice patties before plowing over plants and grass to ensure good nutrients and fertility. New technology and innovations that have

been proven successful should be adapted and applied to the successful growing of *Khao Hom Mali* rice. Natural fertilizers, such as plants and animal dung will result in Bio safe and healthier crops. Good Agricultural Practices recommended by The Ministry of Agriculture and Cooperatives should always be followed to guarantee that harvests are healthy and safe to all consumers. Farmers should also produce rice seedlings for their own use by maintaining strict standards so that it will lower costs for the next harvest season. Farmers should continue to promote and participate in local customs, rituals and festivities that are intertwined with rice and harvest to pass on good the good traditions and customs which are unique to Thai Farmers forever.

Agricultural organizations and Institutions in communities must unite to ensure that harvests receive fair price and to create efficient bargaining rights between community, commercial groups and institutions. Exporters and Industries should find methods to promote *Khao Hom Mali* rice to more foreign markets and expand trade to new countries. The central government should intervene to make sure that prices are just and inline with local and foreign market conditions. Exporters and Resellers should provide adequate and just information about the price of rice. Private and Government sectors must work together to develop sustainable irrigation systems and contingency plans to ensure that there is adequate supply of water during droughts and inconsistent rainfall. Restrictions on harmful chemicals in fertilizers, pesticides and nutrients should be strictly enforced to ensure that rice crops are safe from toxic chemicals and consumers be provided with safe and healthy *Khao Hom Mali* Rice. Private and Government offices and organizations should provide sufficient training and make new knowledge and training available to all farmers. Private and Government institutions should act as role models by demonstration and practice.

Additional research is needed in the study of proper and efficient storage facilities that farmers can adapt and innovate locally. Research into preserving local rice strains should be supported and undertaken to make sure that local rice strains are not lost and become extinct forever.

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