

Rice Landrace (*Oryza sativa* L.) Field Survey and Collection in Xiengkhouang and Houaphan Provinces of Laos in 2014

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Summary

Rice (*Oryza sativa* L.) is a staple food in the Lao People's Democratic Republic (Lao P.D.R or Laos). It is grown and consumed nationwide and recently in this country both modern and traditional rice varieties have been used. Diversity of variety and its conservation are important for future use of such genetic resources. The provinces of Xiengkhouang and Houaphan, located in the north eastern region of Laos, are well known as major producers of Khao Kai Noi (KKN), a traditional rice variety. In order to observe the diversity of rice, especially of KKN in these two provinces, we conducted a survey and sample collection during the harvest season from October 16th to November 1st, 2014. We visited paddy fields where KKN was found. We identified and interviewed the farm owners and requested for rice panicles. We majorly focused on the collection of KKN but also collected other traditional rice varieties that were grown in the same farmer's paddy field. In total we collected 60 samples from both the provinces for future utilization and germplasm study. Thirty-two samples were collected from Xiengkhouang province which comprised of 25 accession of KKN and 7 accessions of other traditional rice. Whereas, twenty-eight accession comprised of 24 and 4 of KKN and other rice, respectively were collected from Houaphan province. All samples together with passport data were stocked in the Lao national genebank, Agriculture Research Center (or Napork center), National Agriculture and Forestry Research Institute (NAFRI) for future utilization and study of this germplasm.

Introduction

Rice (*Oryza sativa* L.) is the main staple food in Laos and its production is prioritized over other agricultural processes. Rice genetic resources were surveyed and collected throughout the country during 1995-2000 (Rao *et al.* 2006a). So far 13, 192 accessions of cultivated rice were collected and conserved in the Lao National Genebank, Agriculture Research Center, National Agriculture and Forestry Research

Institute (NAFRI). The collection included Khao Kai Noi (KKN), a landrace with good eating quality due to its softness and aroma. Another KKN collection mission was performed individually in Xiengkhouang and Houaphan provinces in 2008 and its morphological data were reported by Bounphanousay *et al.* 2009. Within the KKN group, varieties are distinguished by farmers, for example, KKN Leuang (Yellow), KKN Deng (Red) and KKN Lai (Stripe). This germplasm was defined as a “genebank population” and its genetic diversity was examined (Vilayheuang *et al.*, in press).

Recently, KKN has been strongly promoted to grow not only for daily consumption, but as a high-value crop for international trade with neighbouring countries and also as a raw material in industry (Worklivelaos, 2014). Genetic diversity and population structure may change with time and human activities and for efficient conservation of such valuable rice, recent diversity of its on-farm population should be studied to allow comparison with genebank materials. Therefore, in this survey, we collected KKN and other traditional rice varieties (landraces) from farmers' fields during the harvest season in Laos.

Methods

All members were gathered at the Vientiane Capital and travelled by car to Xiengkhouang using the 13th South road through the Paksan district, Borikhamxay province. In Xiengkhouang, primary survey and collection was carried out in the Khoun district, then the team moved to Houaphan province the next day (Table 1). The team completed the survey in Houaphan province and returned to Xiengkhouang province to resume surveys and collections. Every district of these two provinces was surveyed. We went to the provincial borders between Xiengkhouang and Luang Prabang, Houaphan and Luang Prabang. We also went close to the Laos-Vietnam border in the Nonghet district, Xiengkhouang province.

The team went immediately to the farmer's residences or farms in remote target areas and asked for

Table 1. Itinerary of the survey in 2014 in Laos

Day	Month	Date	Activities
1	Oct	16	Thu Travelled from Vientiane to Khoun district, Xiengkhouang
2	Oct	17	Fri Surveyed in Xiengkhouang
3	Oct	18	Sat Travelled from Xiengkhouang (Phonsavan district) – Houaphan (Sam Neua district)
4	Oct	19	Sun Surveyed in Houaphan (Viengxai district)
5	Oct	20	Mon Surveyed in Houaphan (Sam Neua district – Sop Bao district – Et district)
6	Oct	21	Tue Surveyed in Houaphan (Et district - Sam Neua district)
7	Oct	22	Wed Surveyed in Houaphan (Sam Neua district – Sam Tai district)
8	Oct	23	Thu Surveyed in Houaphan (Sam Tai district – Viengxai district)
9	Oct	24	Fri Surveyed in Houaphan (Viengxai district – Houameuang district)
10	Oct	25	Sat Surveyed in Houaphan (Houameuang district – Viengthong (Hiem) district)
11	Oct	26	Sun Travelled from Houaphan (Viengthong district) to Xiengkhouang (Kham district)
12	Oct	27	Mon Surveyed in Xiengkhouang (Kham district – Nonghet district – Phonsavan district)
13	Oct	28	Tue Surveyed in Xiengkhouang (Phonsavan district)
14	Oct	29	Wed Surveyed in Xiengkhouang (Phonsavan district – Kham district)
15	Oct	30	Thu Surveyed in Xiengkhouang (Phonsavan district – Mok district)
16	Oct	31	Fri Surveyed in Xiengkhouang (Phonsavan district – Khoun District)
17	Nov	1	Sat Travelled back from Xiengkhouang (Phonsavan district) to Vientiane

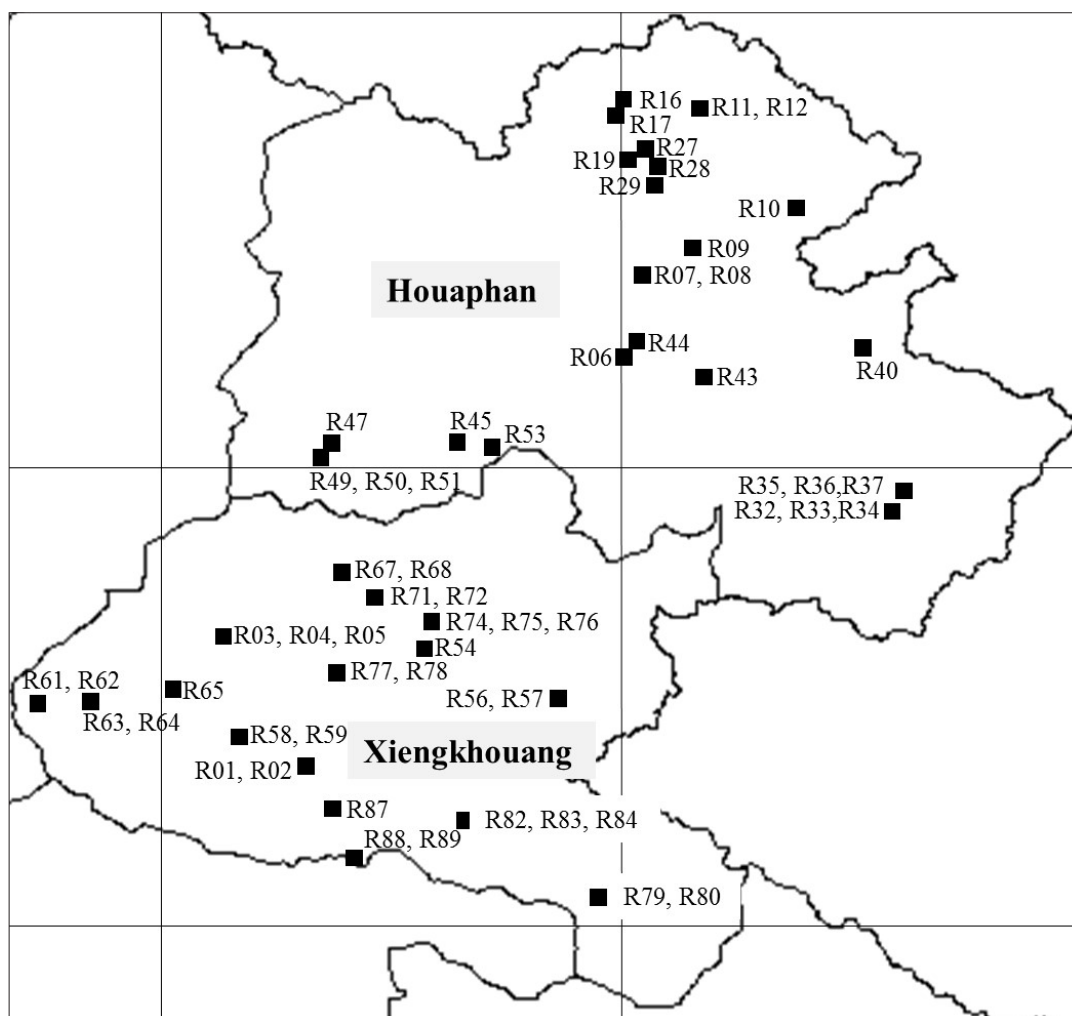


Fig. 1. Map of Xiengkhouang and Houaphan provinces showing the collection sites of rice landraces (*O. sativa* L.) in 2014. R followed by a number is the sample ID given for this collection. R; rice

landraces of rice (*O. sativa* L.). The rice seed sample was collected once the permission from the owner (farmer) was granted according to the code of conduct of the International Society for Ethnobiology (<http://www.ethnobiology.net>). Photo and passport data for each collected sample were recorded according to the collection form, which is a form developed by National Institute of Agrobiological Science (NIAS), Japan. GPS data was obtained by GARMIN OREGON 300. This collection trip was mainly focused on KKN, but if the farmer grew other rice varieties in the same field, those varieties were also collected. However, we did not collect other rice from farmers who did not grow KKN.

The method of collection proceeded as follows: After the farmer consented to give the sample, we collected 5 panicles from different individual plants and placed them in a paper bag as one accession. The accession numbers were assigned in numeric sequence from #1 written on the paper bag in which the samples were kept and these numbers were identical to 001 on the collection form. Then, numbers were further assigned as R01 in the summary table (Table 1), where R refers to rice. The farmer (owner) was interviewed by following the form and other additional information, such as usage, growing area and total yield.

Results and Discussion

We surveyed two provinces, Houaphan and Xiengkhouang. A total of 15 districts and 40 villages were included in the survey. Geographical data on sampling sites were recorded and plotted on the map

(Fig. 1). A rice genetic resources survey in Laos was conducted during 1995-2000 to collect cultivated rice throughout the country of Laos (Rao *et al.* 2006a). In the present collection, we focused on the KKN landrace in its major production provinces (Houaphan and Xiengkhouang). In the areas we visited, KKN and other rice landraces could be found and collected in almost every district in both provinces. We collected 32 accessions comprised of 25 and 7 of KKN and other rice, respectively, in Xiengkhouang province. Twenty-eight samples were collected from Houaphan province including 24 and 4 samples of KKN and other rice, respectively. A total of 60 accessions of rice (49 KKN and 11 others) were collected from both provinces (Table 2, 3).

The KKN (49 accessions) including 8 diverse name subgroups (Table 2) found in this survey were: KKN Leuang (yellow), KKN Deng (red), KKN Lai (strip), KKN Khao (white), KKN Dam (black), KKN Met Noi (small grain), KKN Met Yai (big grain) and KKN with no extension (KKN). The diversity of the KKN group is still maintained among the farmers, because people in this area prefer the taste and rather than the improved ones. The previous KKN collection was conducted in 2008 in Xiengkhouang and Houaphan provinces (Bounphanousay *et al.* 2009) produced four distinct name subgroups: KKN Deng (red), KKN Leuang (yellow), KKN Lai (striped) and KKN Lai-Dam (striped-black). Ten variant names within KKN were reported by Rao *et al.* 2006b.

Most farmers grew more than one variant of KKN in their single-family paddy field because they can serve different purposes, for example, KKN Lai could be sold for a higher price, but other KKN forms could be produced in higher yield (according to a farmer in Xiengkhouang). Some families grew KKN and other rice on separate plots in the same field. We collected all rice varieties from those farmers, however, the proportion of other rice was smaller than that of KKN in both Xiengkhouang and Houaphan provinces. This indicated that currently KKN was well adapted to this environment.

The sample passport data (60 accessions) and related information was transferred from the collection form to Table 3. In addition, their photos were recorded (Photo 1 - 60). After the survey was completed,

Table 2. Collection summary of Khao Kai Noi (KKN) and others

Name		Number
Khao Kai Noi	R29, R56, R17, R65	4
Khao Kai Noi Dam	R01	1
Khao Kai Noi Deng	R03, R11, R16, R34, R36, R45, R47, R51, R53, R59, R64, R71, R76, R77	14
Khao Kai Noi Khao	R19, R35, R50, R54, R58, R63, R72, R75, R78, R82, R88	11
Khao Kai Noi Lai	R10, R33, R74	3
Khao Kai Noi Leuang	R02, R04, R06, R07, R08, R09, R28, R40, R43, R44, R67, R87	12
Khao Kai Noi Met Noi	R62	1
Khao Kai Noi Met Yai	R61	1
Others	R27, R37, R68, R80, R79, R83, R57, R05, R32, R49, R84, R89, R12	13
Total		60

the samples together with passport data were stocked in the Lao National Genebank at the Agriculture Research Center, NAFRI, Vientiane, Laos.

Two samples, R88 and R89, were collected from Pu village, Thathom district, Xaysomboun province (Fig. 1, Table 3). This is actually the endpoint of Xienkhouang or the provincial border between Xiengkhouang and Xaysomboun provinces. This province was previously a district of Xiengkhouang, then it was assigned to a new province “Xaysomboun” just two years before this collection mission. The farmer

or the owner of these samples was still holding a Xiengkhouang ID card and family registration book (according to a farmer, Mr. Khampern), thus two provinces, Xiengkhouang and Houaphan were counted in this report.

Acknowledgements

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Table 3. List and passport data of rice (*Oryza sativa* L.) samples collected in Xiengkhouang (XK) and Houaphan (HP) provinces, Laos during Oct 16th - Nov 1st, 2014

Ent. No.	Sample ID#	Coll. Date	Status ^{*1)}	Local name	Sample ^{*2)}	Provinces	Districts	Villages	Latitude	Longitude	Alt. (m)	Condition ^{*3)}	Collection	Remarks
1	R01	16-Oct	4	Khao Kai Noi Dam	In	XK	Khoun	Na Ou	N 19-21-05.6	E 103-19-39.7	1087	5-1-1-2-3	Seed	Mrs. Kham On. Neither fertilizer nor pesticides were applied; Only two Khao Kai Noi grew in this family field (R01 and R02).
2	R02	16-Oct	4	Khao Kai Noi Leuang	In	XK	Khoun	Na Ou	N 19-21-05.6	E 103-19-39.7	1087	5-1-1-2-3	Seed	Mrs.Kham On. No fertilizer is used.
3	R03	17-Oct	4	Khao Kai Noi Deng	In	XK	Phoukoud	Poung Man	N 19-38-05.4	E 103-07-58.3	1073	5-1-1-2-3	Seed	Mrs. Siphon. Sale to Vietnamese bussiness man.; Culm length: 90 cm; Neither fertilizer nor pesticides were applied; Some product sold to Beerlao company.
4	R04	17-Oct	4	Khao Kai Noi Leuang	In	XK	Phoukoud	Poung Man	N 19-38-05.4	E 103-07-58.3	1073	5-1-1-2-3	Seed	Same farmer with R03. Culm length : 120 cm
5	R05	17-Oct	4	Khao Leuang	In	XK	Phoukoud	Poung Man	N 19-38-05.4	E 103-07-58.3	1073	5-1-1-2-3	Seed	Same owner with R03 and R04. Culm length : 110 cm
6	R06	18-Oct	4	Khao Kai Noi Leuang	In	HP	Sam Neua	Phonxay	N 20-14-14.8	E 104-01-25.9	1195	6-1-1-2-3	Seed	Mrs. Somphone. Culm length : 130 cm; Yield about 4 ton/ha; this family grew 2 ha; Neither fertilizer nor pesticides were applied.
7	R07	19-Oct	4	Khao Kai Noi Leuang	In	HP	Sam Neua	Neua	N 20-25-38.2	E 104-02-3.42	956	5-1-1-2-3	Seed	Mr. Vieng. Culm length : 120 cm; grew 2,300 m ² ; Yield about 4 ton/ha.
8	R08	19-Oct	4	Khao Kai Noi Leuang	In	HP	Sam Neua	Neua	N 20-25-38.2	E 104-02-3.42	956	5-1-1-2-3	Seed	Same owner with R07; Culm length: 120 cm; Neither fertilizer nor pesticides were applied.
9	R09	20-Oct	4	Khao Kai Noi Leuang	In	HP	Viengxai	Na Poug	N 20-28-14.5	E 104-09-05.4	855	6-1-1-2-3	Seed	Mrs. Nam. Culm length: 110 cm; Neither fertilizer nor pesticides were applied.
10	R10	20-Oct	4	Khao Kai Noi Lai	In	HP	Sop Bao	Sop Hao	N 20-33-40.7	E 104-26-59.8	230	5-1-1-2-3	Seed	Mr. Phosy. Culm length: 110 cm; Yield about 5 ton/ha; paddy 4,000 kip/kg. This family planted Khao Kai Noi (KKN) and N79 (Vietnamese rice); more aromatic than other type of KKN.
11	R11	20-Oct	4	Khao Kai Noi Deng	In	HP	Xiengkhor	Na Meuang	N 20-47-10.8	E 104-09-22.5	261	6-1-1-2-3	Seed	Mr. Out. Culm length: 120 cm; grew 0.5 ha; Yield about 4.7 ton/ha; Neither fertilizer nor pesticides were used.
12	R12	20-Oct	4	Khao Suan Huang	In	HP	Xiengkhor	Na Meuang	N 20-47-10.8	E 104-09-22.5	261	6-1-1-2-3	Seed	Same owner with R11. Culm length : 110 cm; Same owner woth R11.
13	R16	21-Oct	4	Khao Kai Noi Deng	In	HP	Et	Phieng Yang	N 20-48-06.8	E 104-00-20.8	260	6-1-1-2-4	Seed	Mr. Kai Yeng. Culm length : 110 cm; Yield about 6 ton/ha; Neither fertilizer nor pesticides were used; there were small and bigger grain, but they preferred big one; modern variety also grew in this family field.
14	R17	21-Oct	4	Khao Kai Noi	In	HP	Et	Dai	N 20-46-38.6	E 103-59-35.8	286	6-1-1-2-4	Seed	Mr. Sermchit. Culm length : 120 cm; Neither fertilizer nor pesticides were used; Yield about 3.3 ton/ha; modern variety (TDK, Dok Kham Khao), also was also grown here.
15	R19	21-Oct	4	Khao Kai Noi Khao	In	HP	Et	Houay Kok	N 20-42-34.5	E 104-01-22.0	708	6-1-1-2-	Seed	Mr. Oun. Culm length : 130 cm; planted 0.3 ha; Khao Pae and Khao Viet also grew.
16	R27	21-Oct	4	Bray, Bet Soua	P	HP	Sam Neua	Phou Jaeng	N 20-41-12.6	E 104-02-56.8	1022	6-2-1-2-4	Seed	Mr. Porye; Neither fertilizer nor pesticides were used.
17	R28	21-Oct	4	Khao Kai Noi Leuang	In	HP	Sam Neua	Sa Naen	N 20-39-17.5	E 104-04-39.1	916	6-1-1-2-3	Seed	Farmer name: Mr .Bounphone. Culm length: 140 cm; Yield about 5.88 ton/ha; planted 0.85 ha; Neither fertilizer nor pesticides were used.
18	R29	21-Oct	4	Khao Kai Noi	In	HP	Sam Neua	Nong Khang	N 20-37-07.7	E 104-04-36.6	1042	6-1-1-2-3	Seed	Mr. Khen. Culm length: 140 cm; No pesticides used; Nitrogen fertilizer at the seedling stage.

Table 3 (Continued).

Ent. No.	Sample ID#	Coll. Date	Status ^{*1)}	Local name	Sample ^{*2)}	Provinces	Districts	Villages	Latitude	Longitude	Alt. (m)	Condition ^{*3)}	Collection	Remarks
20	R33	22-Oct	4	Khao Kai Noi Lai	In	HP	Sam Tai	Siengdii	N 19-55-58.5	E 104-37-44.2	648	6-1-1-2-3	Seed	Same owner with R32. Culm length : 110 cm; grew separate plot but same field with other traditional rice.
21	R34	22-Oct	4	Khao Kai Noi Deng	In	HP	Sam Tai	Siengdii	N 19-55-58.5	E 104-37-44.2	676	6-1-1-2-3	Seed	Mr. Panit. Culm length : 110 cm
22	R35	22-Oct	4	Khao Kai Noi Khao	In	HP	Sam Tai	Nala	N 19-56-22.7	E 104-37-25.0	684	6-1-1-2-3	Seed	Mr.Thongloun. Culm length : 130 cm; Only KKN planted; Yield 3.6 ton/ha; planted 0.5 ha; Neither pesticides nor fertilizer were applied.
23	R36	22-Oct	4	Khao Kai Noi Deng	In	HP	Sam Tai	Nala	N 19-56-22.7	E 104-37-25.0	684	6-1-1-2-3	Seed	Same owner with R36. Culm length : 130 cm; Same owner with R35.
24	R37	22-Oct	4	Khao Borng	In	HP	Sam Tai	Nala	N 19-56-22.7	E 104-37-25.0	684	6-1-1-2-3	Seed	Same owner with R35 and R36. Culm length : 130 cm; Had been cultivated this variety for longtime (from their grandparent) before KKN was introduced.
25	R40	22-Oct	4	Khao Kai Noi Leuang	In	HP	Viengxai	Donkhoun	N 20-15-56.9	E 104-31-45.6	416	6-1-1-2-3	Seed	Mr.Viengphone. Culm length : 130 cm; Single seedling planted; this village they preferred both KKN Leuang and KKN Lai, but this family grew KKN Leuang (or Khao); Neither pesticides nor fertilizer were applied.
26	R43	24-Oct	4	Khao Kai Noi Leuang	In	HP	Sam Neua	Vaen	N 20-12-44.8	E 104-10-20.5	765	6-1-1-2-3	Seed	Mr.Onkham. Culm length : 110 cm; Yield about 5 ton/ha; This village, all farmer grew KKN; Neither pesticides nor fertilizer were applied.
27	R44	24-Oct	4	Khao Kai Noi Leuang	In	HP	Sam Neua	Done	N 20-16-37.1	E 104-02-38.3	1122	6-1-1-2-3	Seed	Mr.Pheng. Culm length : 150 cm; Yield about 5.4 ton/ha; This village, all farmer grew KKN; Neither pesticides nor fertilizer were applied.
28	R45	25-Oct	4	Khao Kai Noi Deng	In	HP	Houameuang	Phiengdi	N 20-03-33.4	E 103-38-71.2	562	6-1-1-2-3	Seed	Mr.Phanvilay. Culm length : 110 cm; Yield about 2.8 ton/ha; planted 0.56 ha; Neither pesticides nor fertilizer were applied.
29	R47	25-Oct	4	Khao Kai Noi Deng	In	HP	Viengthong	Thaenhing	N 20-03-41.3	E 103-22-09.3	676	6-1-1-2-3	Seed	Mrs.Jaeng. Culm length: 120 cm; Neither pesticides nor fertilizer were applied.
30	R49	25-Oct	4	Khao Nong	In	HP	Viengthong	Kor Kieng	N 20-01-14.5	E 103-20-52.9	643	6-1-1-2-3	Seed	Mr.On. Culm length : 120 cm; Yield about 6 ton/ha; Planted 0.2 ha; Neither pesticides nor fertilizer were applied.
31	R50	25-Oct	4	Khao Kai Noi Khao	In	HP	Viengthong	Kor Kieng	N 20-01-14.5	E 103-20-52.9	643	6-1-1-2-3	Seed	Same owner with R49. Culm length : 120 cm; This village and near by farmer grew KKN Khao and KKN Deng.
32	R51	25-Oct	4	Khao Kai Noi Deng	In	HP	Viengthong	Kor Kieng	N 20-01-14.5	E 103-20-52.9	643	6-1-1-2-3	Seed	Same owner with R49, R50. Culm length : 120 cm
33	R53	25-Oct	4	Khao Kai Noi Deng	In	HP	Houameuang	Soplao	N 20-01-31.0	E 103-42-55.8	532	6-1-1-2-3	Seed	Mr. Phonema. Culm length : 130 cm; Neither pesticides nor fertilizer were applied.
34	R54	26-Oct	4	Khao Kai Noi Khao	In	XK	Kham	Jom Thong Tai	N 19-37-14.3	E 103-34-05.4	597	6-1-1-2-3	Seed	Mr. Khoun. Culm length : 120 cm; Yield 5.3 ton/ha; Planted 0.15 ha, Neither pesticides nor fertilizer were applied.
35	R56	26-Oct	4	Khao Kai Noi	In	XK	Nonghet	Khangphannien	N 19-30-54.8	E 103-51-23.4	1187	6-1-1-2-3	Seed	Mr.Vasamour. Culm length : 100 cm; Planted just small plot to conserve the variety; Neither pesticides nor fertilizer were applied.
36	R57	26-Oct	4	Khao Lai	In	XK	Nonghet	Khangphannien	N 19-30-54.8	E 103-51-23.4	1187	6-1-1-2-3	Seed	Same owner with R56. Culm length : 90 cm; Planted at the same field with KKN.
37	R58	27-Oct	4	Khao Kai Noi Khao	In	XK	Phonsavan	Na O	N 19-25-03.6	E 103-10-29.5	1084	6-1-1-2-3	Seed	Mr. Touy. Culm length : 100 cm; Yield about 5.4 ton/ha; planted 0.7 ha; Little fertilizer used, but no pesticide; They prefer KKN Deng and KKN Khao due to their high yield. No other than KKN were grown this field.

Table 3 (Continued).

Ent. No.	Sample ID#	Coll. Date	Status ^{*1)}	Local name	Sample ^{*2)}	Provinces	Districts	Villages	Latitude	Longitude	Alt. (m)	Condition ^{*3)}	Collection	Remarks
39	R61	28-Oct	4	Khao Kai Noi Met Yai	In	XK	Phoukoud	Namchat	N 19-29-05.2	E 102-43-21.5	817	6-1-1-2-3	Seed	Mr. Phaivan. Culm length : 150 cm; Only this family planted KKN; Introduced from Nong Tang more than more than years ago. Planted 0.3 ha; Yield about 7.8 ton/ha; Neither fertilizer nor pesticides were applied.
40	R62	28-Oct	4	Khao Kai Noi Met Noi	In	XK	Phoukoud	Namchat	N 19-29-05.2	E 102-43-21.5	817	6-1-1-2-3	Seed	Same owner with R61. Culm length : 110 cm.
41	R63	28-Oct	4	Khao Kai Noi Khao	In	XK	Phoukoud	Xiengnga	N 19-29-04.8	E 102-51-45.2	1132	5-1-1-2-3	Seed	Mr. Khamban. Culm length : 120 cm; Only this rice was grown; Neither fertilizer nor pesticides were applied.
42	R64	28-Oct	4	Khao Kai Noi Deng	In	XK	Phoukoud	Xiengnga	N 19-29-04.8	E 102-51-45.2	1132	5-1-1-2-3	Seed	Same owner with R63. Culm length : 110 cm.
43	R65	28-Oct	4	Khao Kai Noi	In	XK	Phoukoud	Sai	N 19-31-50.7	E 103-01-49.9	1040	5-1-1-2-3	Seed	Mr. Jarn Noansy. Culm length : 90 cm; Yield about 4 ton/ha; Planted 0.8 ha; Neither fertilizer nor pesticides were applied. Manure was used; He had grown KKN for 13 years. Not only KKN was grown here.
44	R67	29-Oct	4	Khao Kai Noi Leuang	In	XK	Kham	Namsai	N 19-45-24.1	E 103-23-01.8	1031	6-1-1-2-3	Seed	Mr. Phor Pao. Culm length : 110 cm; This village, farmer used KKN and Chao Mali; Threshing machine used; Neither fertilizer nor pesticides were applied.
45	R68	29-Oct	4	Khao Chao Mali	In	XK	Kham	Namsai	N 19-45-24.1	E 103-23-01.8	1031	6-1-1-2-3	Seed	Same owner with R67. Culm length : 120 cm.
46	R71	29-Oct	4	Khao Kai Noi Deng	In	XK	Kham	Naphan	N 19-43-29.3	E 103-27-42.5	874	6-1-1-2-3	Seed	Mr. Guxong. Culm length : 120 cm; Yeild about 6 ton/ha; Planted 0.7 ha; Planted both KKN deng and KKN Khao; Some family in the village grew Khao Chao Teer; Neither fertilizer nor pesticides were applied; Harvested by hand aand threshing machine used.
47	R72	29-Oct	4	Khao Kai Noi Khao	In	XK	Kham	Naphan	N 19-43-29.3	E 103-27-42.5	874	6-1-1-2-3	Seed	Same owner with R71. Culm length : 110 cm.
48	R74	29-Oct	4	Khao Kai Noi Lai	In	XK	Kham	Fai	N 19-39-46.6	E 103-35-07.1	587	5-1-1-2-3	Seed	Mrs. Mae Tieng. Culm length : 110 cm; Planted 1.8 ha; Yield about 3.3 ton/ha; This KKN Lai was the most expensive among KKNs. KKN deng was introduced from Sam Neua district, Houaphan province about 4 years ago. Fertilizer used but no pesticides.
49	R75	29-Oct	4	Khao Kai Noi Khao	In	XK	Kham	Fai	N 19-39-46.6	E 103-35-07.1	587	5-1-1-2-3	Seed	Same owner with R74. Culm length: 110 cm.
50	R76	29-Oct	4	Khao Kai Noi Deng	In	XK	Kham	Fai	N 19-39-46.6	E 103-35-07.1	587	5-1-1-2-3	Seed	Same owner with R74, R75. Culm length: 120 cm.
51	R77	29-Oct	4	Khao Kai Noi Deng	In	XK	Phonsavan	Gnod Ngeum	N 19-33-28.3	E 103-22-43.5	1127	5-1-1-2-3	Seed	Mr. Ket. Culm length: 90 cm; Yield about 4 ton/ha; Neither fertilizer nor pesticides applied.
52	R78	29-Oct	4	Khao Kai Noi Khao	In	XK	Phonsavan	Gnod Ngeum	N 19-33-28.3	E 103-22-43.5	1127	5-1-1-2-3	Seed	Same owner with R77. Culm length: 80 cm.
53	R79	30-Oct	4	Khao Kai Deng	P	XK	Mok	Na Khae	N 19-04-47.4	E 103-57-09.0	468	6-1-1-2-	Seed	Mr. Dourvang. Culm length: 140 cm; Yield 4 ton/ha; Planted 2.5 ha; Fifty % of thire land for KKN Deng and other for Khao Chao (non glutinous rice); Neither fertilizer nor pesticides applied.
54	R80	30-Oct	4	Khao Chao, Khao Sanleuang	P	XK	Mok	Na Khae	N 19-04-47.4	E 103-57-09.0	468	6-1-1-2-	Seed	Same owner with R79. Culm length: 140 cm.

Table 3 (Continued).

Ent. No.	Sample ID#	Coll. Date	Status ^{*1)}	Local name	Sample ^{*2)}	Provinces	Districts	Villages	Latitude		Longitude		Alt. (m)	Condition ^{*3)}	Collection	Remarks
56	R83	30-Oct	4	Khao La	In	XK	Khoun	Dokmai	N	19-14-07.2	E	103-40-06.6	1345	6-1-1-2-3	Seed	Same owner with R82. Culm length : 110 cm.
57	R84	30-Oct	4	Khao Pong	In	XK	Khoun	Dokmai	N	19-14-07.2	E	103-40-06.6	1345	6-1-1-2-3	Seed	Same owner with R82. Culm length : 110 cm.
58	R87	31-Oct	4	Khao Kai Noi Leuang	In	XK	Khoun	Nahor	N	19-16-52.2	E	103-21-28.9	1086	6-1-1-2-3	Seed	Mr. Xingxong; Yield about 5 ton/ha; Planted 0.6 ha; Threshing machine used; Neither fertilizer nor pesticide were used.
59	R88	1-Nov	4	Khao Kai Noi Khao	In	Xaisomboun	Thathom	Pu	N	19-01-35.4	E	103-07-20.6	347	5-1-1-2-3	Seed	Mr. Khampern. Culm length : 110 cm; This field used two rice: KKN and Khao Saiya (Saya), Seeds were shared by relative within the village.
60	R89	1-Nov	4	Khao Saiya	In	Xaisomboun	Thathom	Pu	N	19-01-35.4	E	103-07-20.6	347	5-1-1-2-3	Seed	Same owner with R88. Culm length : 140 cm.

*1) 1; Wild, 4; Landrace

*2) In; Individual, P; Population (seeds)

*3) Topography-Site-Stoniness-Soil texture-Drainage

Topography: 1; swamp, 2; flood plain, 3; plain level, 4; undulation, 5; hilly, 6; mountainous, 7; other (specify)

Site: 1; level, 2; slope, 3; summit, 4; depression

Stoniness: 1; none, 2; low, 3; medium, 4; rocky

Soil texture: 1; sand, 2; loam, 3; clay, 4; silt, 5; highly organic

Drainage: 1; poor, 2; moderate, 3; good, 4; excessive



Photo 1. Khao Kai Noi Lai Dam (ID#R01)



Photo 2. Khao Kai Noi Leuang (ID#R02)



Photo 3. Khao Kai Noi Deng (ID#R03)



Photo 4. Khao Kai Noi Leuang (ID#R04)



Photo 5. Khao Leuang (ID#R05)



Photo 6. Khao Kai Noi Leuang (ID#R06)



Photo 7. Khao Kai Noi Leuang (ID#R07)



Photo 8. Khao Kai Noi Leuang (ID#R08)



Photo 9. Khao Kai Noi Leuang (ID#R09)



Photo 10. Khao Kai Noi Lai (ID#R10)



Photo 11. Khao Kai Noi Deng (ID#R11)



Photo 12. Khao Suan Huang (ID#R12)



Photo 13. Khao Kai Noi Deng (ID#R16)



Photo 14. Khao Kai Noi (ID#R17)



Photo 15. Khao Kai Noi Khao (ID#R19)



Photo 16. Bray or Bet Soua (ID#R27)



Photo 17. Khao Kai Noi Leuang (ID#R28)



Photo 18. Khao Kai Noi (ID#R29)



Photo 19. Khao Meuang Lan (ID#R32)



Photo 20. Khao Kai Noi Lai (ID#R33)



Photo 21. Khao Kai Noi Deng (ID#R34)



Photo 22. Khao Kai Noi Khao (ID#R35)



Photo 23. Khao Kai Noi Deng (ID#R36)



Photo 24. Khao Borng (ID#R37)



Photo 25. Khao Kai Noi Leuang (ID#R40)



Photo 26. Khao Kai Noi Leuang (ID#R43)



Photo 27. Khao Kai Noi Leuang (ID#R44)



Photo 28. Khao Kai Noi Deng (ID#R45)



Photo 29. Khao Kai Noi Deng (ID#R47)



Photo 30. Khao Nong (ID#R49)



Photo 31. Khao Kai Noi Khao (ID#R50)



Photo 32. Khao Kai Noi Deng (ID#R51)



Photo 33. Khao Kai Noi Deng (ID#R53)



Photo 34. Khao Kai Noi Khao (ID#R54)



Photo 35. Khao Kai Noi (ID#R56)



Photo 36. Khao Lai (ID#R57)



Photo 37. Khao Kai Noi Khao (ID#R58)



Photo 38. Khao Kai Noi Deng (ID#R59)



Photo 39. Khao Kai Noi Met Yai (ID#R61)



Photo 40. Khao Kai Noi Met Noi (ID#R62)



Photo 41. Khao Kai Noi Khao (ID#R63)



Photo 42. Khao Kai Noi Deng (ID#R64)



Photo 43. Khao Kai Noi (ID#R65)



Photo 44. Khao Kai Noi Leuang (ID#R67)



Photo 45. Khao Chao Mali (ID#R68)



Photo 46. Khao Kai Noi Deng (ID#R71)



Photo 47. Khao Kai Noi Khao (ID#R72)



Photo 48. Khao Kai Noi Lai (ID#R74)



Photo 49. Khao Kai Noi Khao (ID#R75)



Photo 50. Khao Kai Noi Deng (ID#R76)



Photo 51. Khao Kai Noi Deng (ID#R77)



Photo 52. Khao Kai Noi Khao (ID#R78)



Photo 53. Khao Kai Deng (ID#R79)



Photo 54. Khao Chao or Khao Sanleuang (ID#R80)



Photo 55. Khao Kai Noi Khao (ID#R82)



Photo 56. Khao La (ID#R83)



Photo 57. Khao Pung (ID#R84)



Photo 58. Khao Kai Noi Leuang (ID#R87)



Photo 59. Khao Kai Noi Khao (ID#R88)



Photo 60. Khao Saiya (ID#R89)