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# Findings of an Upland Rice Farming Study Using a Participatory Mapping Approach in Sarawak (Malaysia)

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## Introduction

Cultivation of rice plays an important role in food security and nutrition in the life of the Eastern Penan, a former hunter-gatherer society in Borneo (Sarawak, Malayisa). Since the 1960s the Eastern Penan started to cultivate rice, which was introduced to them by missionaries and the neighbouring communities (Janowski & Langub 2011). The main farming practice of the Penan, upland rice cultivation, is by the means of slashing and burning in a shifting cultivation system. Recently, a social transition in the Penan communities and other factors, such as industrial logging and plantations, increased the pressure on natural resources (Cramb & Sujang 2011). Therefore, shorter fallow periods, caused by population growth, and the intensive land use led to a decline in the forest ecosystem functionality and soil quality (Li et al. 2014), which in turn affected the rice yield. Sustainable upland rice production is essential to maintaining natural resources and mid- to long-term food security for the locals. To give recommendations for sustainable upland farming practices, a preliminary study in the Penan village of Long Lamai was conducted.

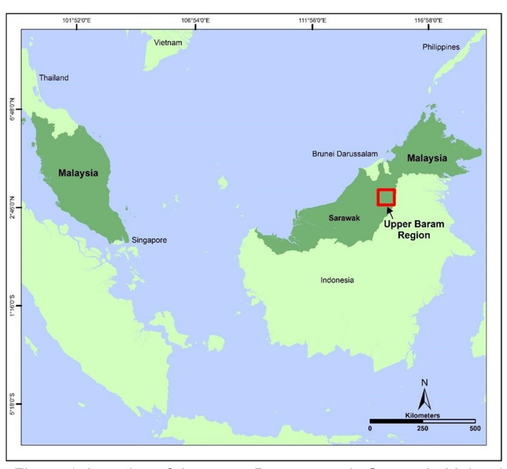


*Figure 1: Location of the upper Baram area in Sarawak, Malaysia*

## Study Area

The village of Long Lamai (population of 600) is located in the upper Baram region in Sarawak (Malaysia) (Figure 1) in a tropical upland rainforest environment. In the ethnic divers landscape, the Eastern Penan of Long Lamai were the first group, who founded a settlement and started to farm upland rice. Access to the village is possible by boat and walking.

## Materials and Methods

A participatory research approach was chosen to gather agronomic and environmental information on upland rice fields* :

- 6 supervised local village researchers
- 127 usable structured interviews
- Spatial references on aerial orthophotos
- Sketch mapping (Fig. 3)
- GIS cartography and analysis

*Figure 2: Local mapping team during interview and localization of farmers upland rice field in the drone image*

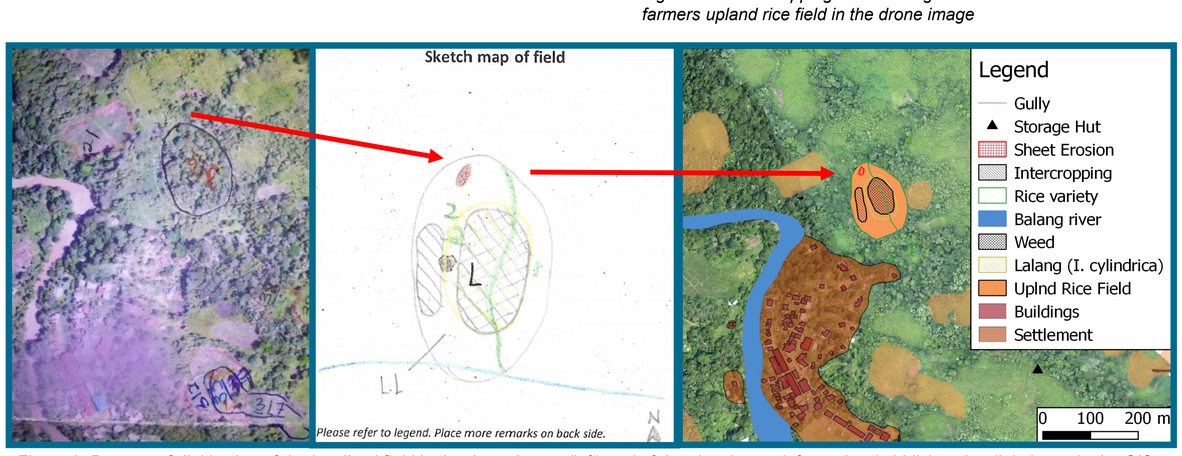


*Figure 3: Process of digitization of the localized field in the drone image (left) and of the sketch map information (middle) to the digital map in the GIS (right).*

* It Includes key variables as chronology of field use, production methods, rice varieties and distribution, yields and weather conditions during cropping as well as information of soil characteristics, soil erosion and fertilizer and pesticide use.

## Results and Discussion

The mapping result can be seen in Figure 4 for field No. 316. The map shows the distribution of the fields, overlaying of fields, different soil segments, weed (Lalang), erosion and landslide occurrences as well as rice varieties distribution. Information from the questionnaires, including distances and field area hectares are linked to the database for every field and segment.

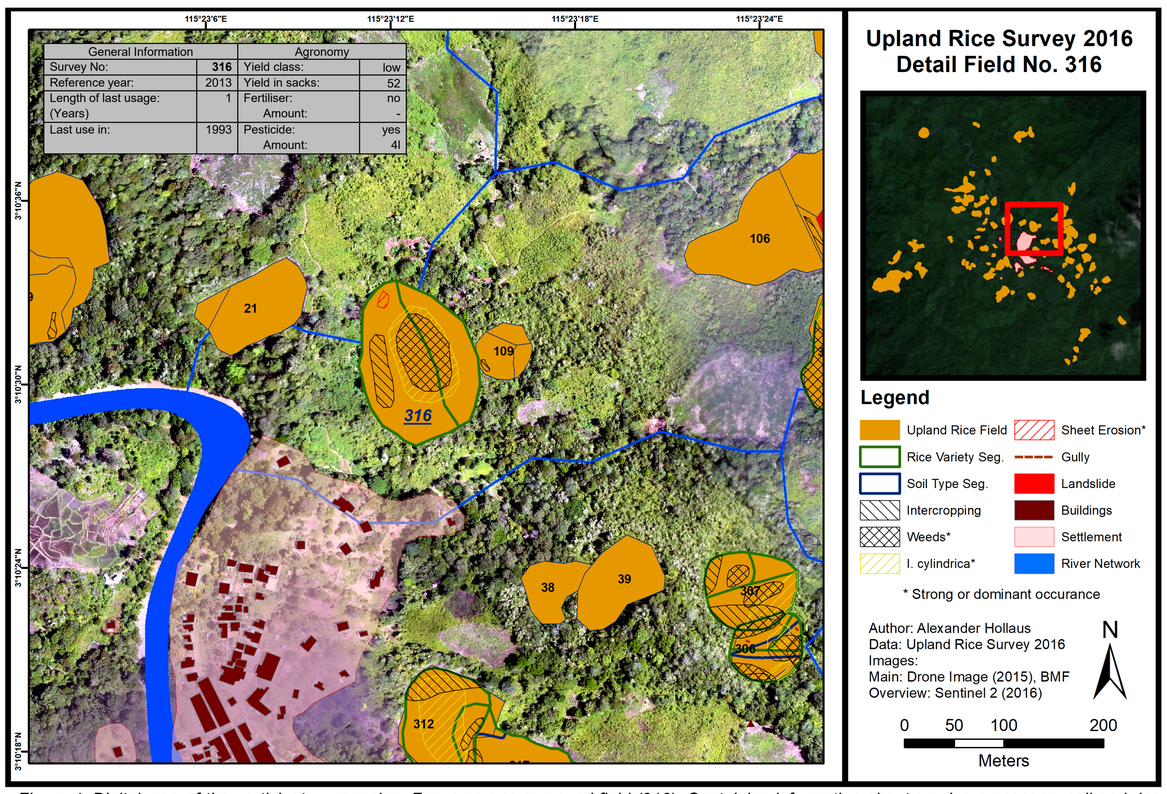


*Figure 4: Digital map of the participatory mapping. Focus on one surveyed field (316). Containing information about erosion processes, soil and rice variety segments and weed occurrence.*

**Descriptive results of the interviews:**

- Rice cultivation period is always **one cropping phase**. The median **fallow period is 6-years**.
- Since 1958 around **65 %** of fields were **used more than 5 times**.
- **Phases of rice cultivation:**
  - **Slashing and burning are mostly** in **July** (dry season) and takes **a month**.
  - Direct **seeding is** started and completed within **August**.
  - **Weeding** is done in **October** and in the subsequent **1-3 month**
  - **Harvesting** is generally in **January and February.**
- **Cultivation practices and yields:**
  - In around **82 %** of interviews **intercropping** was practiced (e.g. corn, cucumber or tapioca).
  - **Weeds** and **pests / diseases** occurred on **94 % and 42 % of fields** respectively.
  - **Fertiliser** application is **not common**, while **pesticides** are used on **53 %** of the fields.
  - On average, the farmers used **3.8 l/ha/y** of **pesticides** (mostly herbicides, e.g. Roundup).
  - The **pesticide** amount applied has **steadily increased** since 2013.
  - Higher **use of pesticide** poorly correlates with **higher yields** (0.217, $p<0.05$).
  - Soil fertility was rated as High / Medium / Low / Degraded with ratios of 28 %, 36 %, 29 %, and 7 % respectively.
  - The **yields** reach a mean of **1.8 t/ha**. Compared to other regional studies (Bruun et al. 2006; Hanafi et al. 2009; Tanaka et al. 2007), this result is very high for a field without fertiliser application. This could be a overestimation by the method (yield in sacks to t/ha).

## Conclusion

With the participatory mapping approach, we understood general farming practices, the cultivation cycle and distribution of fields. A first impression was drawn that the applied farming is showing a trend of shorter fallow periods and higher external inputs. The method still needs improvements in terms of the specification of the subjects asked for.

On the basis of this first study, further research is planned in the “Sustainable Agriculture and Resource Management” Project. A doctoral thesis on farming practices and local knowledge of upland rice cultivation will be conducted.

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