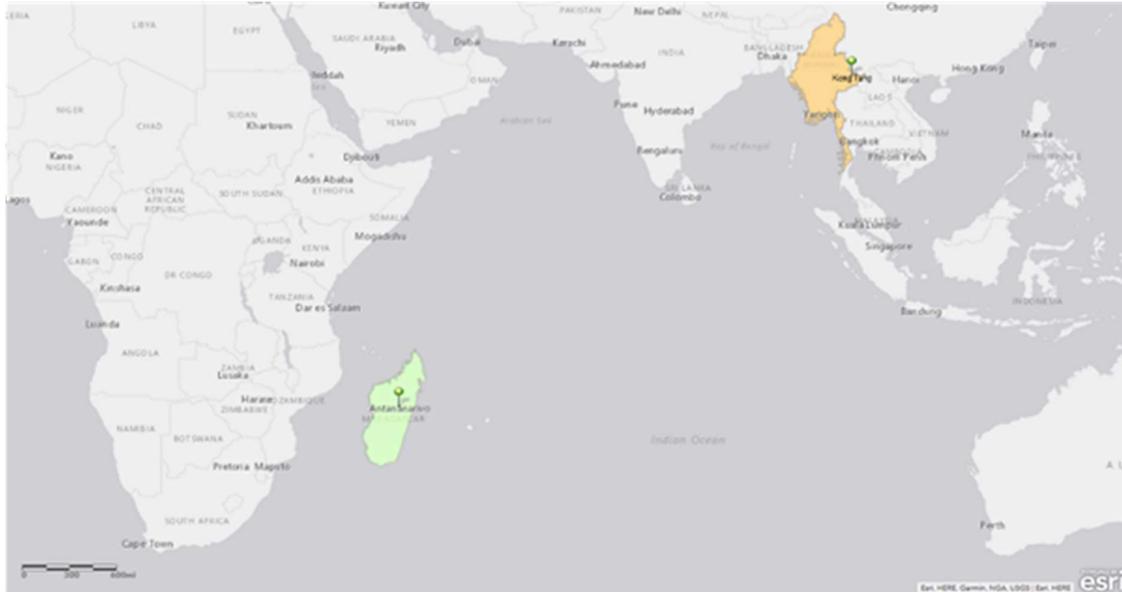


Project update

Project title (Acronym):	ProciNut – Production and Processing of Edible Insects for Improved Nutrition Madagascar and Myanmar (and Thailand)
Geographical focus:	Madagascar, Myanmar, and Thailand
Call reference:	Innovative approaches to processing local foods in Sub-Saharan Africa and Southeast Asia that contribute to improved nutrition and reduce qualitative and quantitative losses (Einzelplan 10, Kapitel 1005, Titel 687 31)
Cooperating partners:	FOFIFA (Madagaskar), HBRS-IZNE (Germany), INMU (Thailand), KU (Thailand), Spectrum SDKN (Myanmar), UoA (Madagaskar), WHH (Madagaskar), YAU (Myanmar)
Duration:	01.03.2018 – 31.12.2022
Budget:	1.214.521,70€ (as of June 2022)





Aim of the project:

The ProciNut project (Production and Processing of Edible Insects for Improved Nutrition) aims to better exploit the nutritional and economic potential of edible insects. It tests different processing techniques of local insect species and expands commercial small-scale farm activities and processing to produce safe and nutritious end products that are able to close seasonal gaps, increase nutritional security of households and improve the economic situation of poor women in Madagascar and Myanmar.

Results:

WP1

Myanmar:

Consumer attitudes towards entomophagy in Myanmar

Myanmar is one of the Southeast Asian countries where eating insects has been practiced for centuries. However, the lack of research on consumer perceptions of edible insects in Myanmar makes it difficult to better realize their potential. A ProciNut study examined customer attitudes towards insect consumption using a binary logistic analysis of data from 863 respondents. The results show that 73% of the respondents consume insects, but only 41% express a positive attitude towards entomophagy. Out of fourteen independent variables, only five variables, namely consumption, age, region, family size, and disgust, have a significant impact on consumer attitudes towards entomophagy. With more than 99% of respondents being familiar with edible insects, insect phobia has no discernible influence on attitudes.

The role of trust in consumers' willingness to eat reared crickets in Myanmar

Despite the popularity of crickets, very few farmers produce them and the farming business is not yet thriving like in other countries, mainly due to the lack of demand from consumers who are still used to only eat crickets collected in the wild. Therefore, this study aimed to identify the effect of the role of trust on attitudes and willingness to eat reared crickets in Myanmar. A sample of 224 respondents from Yangon and Mandalay who had recently eaten wild-harvested crickets was used. Data collection was done through telephone interviews. Confirmatory factor analysis was



Seite 3 von 5

applied for validation and the data were analyzed using structural equation models. The result showed that trust in cricket producers significantly affects attitude and intention to consume, while trust in retailers showed no significant effect on either attitude nor willingness to eat farmed crickets. At the same time, attitude was significantly related to willingness to eat farmed crickets.

Madagascar:

A case study was conducted in the rural community of Sandrandahy in the central highlands of Madagascar, where wild-collected entomophagy is a common practice and malnutrition is pervasive. The data was obtained from a household survey in 2020. Using a systematic cluster sampling with probability proportional to size (PPS), a sample of 216 households was randomly selected in 12 out of 38 villages. Descriptive statistics, correlation and regression analysis were used to show the relative importance of insects for local diets and to test different food security hypotheses. The results show that insects contribute significantly to animal protein consumption, especially during the wet season when other protein sources are scarce. They are a cheap source of protein that the rural population appreciates just as much as meat. There are no significant differences in the amounts of insects consumed by poorer versus wealthier households or between rural and urban households. Insect consumption levels are strongly related to the time spent on wild collection (Dürr and Ratompoarison, 2021).

Another study, based on the same household survey, examines insect consumption behavior in Sandrandahy. Several linear regressions were used to determine factors that explain the differences in the amounts of insects consumed between local consumers. The time households spend harvesting insects, a variable not accounted for in any of the other literature sources, is the most important factor explaining the amount of insects consumed. Given the results, we attempted to explain why socioeconomic factors and most product-related attitude factors play no role in predicting insect consumption patterns in rural Madagascar (Meysing et al. 2021).

WP2

Myanmar:

Production of yellow mealworms (Tenebrio molitor) (Coleoptera: Tenebrionidae) for food and feed in Myanmar

In this study, wheat bran, wheat bran with Chinese cabbage, rice bran with Chinese cabbage, and rice bran were used to assess growth performance of *T. molitor* larvae. The performance of mealworms fed different diets was measured. Among the feeds, mealworm larvae fed wheat bran with Chinese cabbage and rice bran with Chinese cabbage showed the heavier larval weight than only wheat bran and rice bran. According to this experiment, mealworm larvae fed wheat bran supplemented with Chinese cabbage had improved growth rate and increased production efficiency. However, economic studies of costs and benefits are still pending, which is interesting since rice is locally available while wheat bran is imported.

Thailand:

Sustainable production of yellow mealworm for protein food using low-value agricultural by-products

The aim of this research is to assess the growth of the yellow mealworm (*Tenebrio molitor* L.) reared with 4 different vegetable and bran-based feed mixtures. The feed mixtures were rice bran, rice bran mixed with Chinese cabbage, wheat bran and wheat bran mixed with Chinese cabbage. The worm grew healthily and had a life cycle of about 5-5.5 months. Adult larvae fed rice bran



Seite 4 von 5

mixed with Chinese cabbage showed a significantly shorter larval instar duration than larvae fed rice bran, wheat bran mixed with Chinese cabbage, and wheat bran. The survival rate of the yellow mealworm was not significantly different (between 53 and 76%), and the adult larva fed rice bran mixed with Chinese cabbage and rice bran (71 g/tray) and wheat bran (80 g/tray) had similar yields per rearing tray, but had a lower yield than wheat bran mixed with Chinese cabbage (131 g/tray). The estimated production costs of the fresh worm larvae are between 4,070 and 6,742 EUR per ton.

Fermentation of salted crickets and processing into "Nga Pi" and drying of silkworms with the addition of salt

The fermentation of crickets or edible insects is not very well documented but has great potential in Southeast Asian countries as fermented shrimp pastes and sauces are traditionally used to flavor dishes. The products from previous laboratory tests with dried and salted crickets were further processed by fermentation.

Drying silkworms with salt can be recommended as a simple method that can reduce microbiological risk. The salt can limit the growth of microorganisms that can occur during sun drying when temperature and heat cannot be well controlled.

Madagascar:

*Nutritional profile of *Nomadacris septemfasciata* and its prospective use to combat malnutrition in Madagascar*

The red migratory locust (*Nomadacris septemfasciata*) is a species found in abundance in the highlands of Madagascar during the hot and humid season. The aim of this study was to examine the nutrient composition of migratory red locust and to discuss its potential use to improve nutrition. Analysis shows that the protein content of *N. septemfasciata* is the highest among the Orthoptera orders at 77.46% of dry matter. The locust contains all essential amino acids with an good amino acid score according to the FAO / WHO / UNU recommendation with the exception of methionine. The high tryptophan content of 6.17 g / 100 g protein allows this insect to be used as a supplement to foods that are limited in this amino acid, such as rice and tubers, which are staple foods in Madagascar. The lipid fraction represents 8.46% of the dry matter with 14 fatty acids and the dominance of palmitic acid with 23.4%, arachidic acid with 14.9% and 10.8% α -linolenic acid. *N. septemfasciata* powder contains a good omega-3 content of 10.8 g / 100 g fat, content similar to cod liver oil, fish oil and walnut oil. The content of iron (9.99 ± 1.00 mg / 100 g) and zinc (21.16 ± 1.90 g / 100 g) makes the insect a potential source of minerals that can be used to fortify food.

*Small-scale farming of edible *Gryllus bimaculatus* in Madagascar for healthy and sustainable dietary protein*

The aim of the study was to optimize the housing for the production of the two-spotted cricket *Gryllus bimaculatus*, which occurs naturally in the region. Six rearing rooms (2 m × 2.50 m × 2.45 m) were built with double wall structures to control the temperature and relative air to stabilize internal humidity and to minimize the temperature variation between day and night that are characteristic of tropical climates. The reared crickets were fed various feeds such as ready-made poultry feed and vegetable waste from the kitchen. The climatic conditions of the room during the experiment were 28 ± 2 °C for the temperature and $82 \pm 10\%$ relative humidity. From the 200 larvae in the first instar at the beginning we received 130 to 132 adults with a development time of 30 to 43 days. The average fresh weight of an adult cricket was between 1.06 and 1.50 grams. Conclusion: a successful production, the room offers optimal climatic parameters for rearing. The



Seite 5 von 5

survival rate of the larvae was 66%. Both the development time to adult animals and their fresh weight are comparable with previous laboratory results. The produced crickets were eaten immediately after cooking or dried and powdered.

Key statements and policy advice:

- 73% of respondents consume insects, but only 41% have a positive attitude towards entomophagy. However, since almost all respondents are familiar with edible insects, insect phobia has no discernible influence on attitudes. Reluctance due to disgust could be mitigated by more transparency and traceability of the entire supply chain, including the harvest and rearing phase. Food safety guidelines should be established by the government and key participants in the edible insect chain, particularly in relation to the use of chemicals during harvesting and storage and the safe preparation of insects in urban markets.
- Because trust in cricket producers has a more important impact on insect consumption than trust in retailers, producers should seek to gain trust through transparent cricket production processes, stimulate public interest in and improve acceptance of farmed house crickets in order to increase consumption increase.
- In Madagascar, insects make a significant contribution to animal protein consumption, particularly during months when other protein sources are less available and wild-collected insects are seasonally available. They are a cheap source of protein that the rural population appreciates just as much as meat. The time households spend collecting insects is the most important factor explaining the amount of insects eaten. Therefore, the promotion of insect breeding as an agricultural activity, as opposed to wild collection, is recommended in order to close seasonal availability gaps, exploit the enormous potential of edible insects for food security, and strengthen the tradition of entomophagy (Meysing et al. 2021).
- It could be shown that the cricket rearing in Sandrandahy is easily possible due to the local availability of food and the insulating capacity of the rearing rooms and that the local farmers readily and successfully adopted.
- The addition of *N. septemfasciata* powder to the daily ration can help to improve the quality of the Malagasy diet, as well as the intake of proteins and micronutrients.
- Fermentation of edible insects is an easily applicable technique at the household level.
- Salt drying of silkworms can be recommended as a simple method that can reduce the risk of microbiological contamination during drying of insects.