

Rubber agroforestry Breeding Initiative for Smallholders (RUBIS)

ABSTRACT

Hevea brasiliensis is the main source of natural rubber (NR). Smallholders account for 85% of the worldwide NR production. Although Indonesia has the largest plantation area, this country ranks second for the NR production due to its low domestic productivity related to large areas planted with rubber agroforests using unselected rubber seedling material and poor quality NR harvesting technology. Recent conversion of agroforests into monospecific rubber plantation enabled an increase of NR production at the expense of the regulating ecosystem services provided by agroforests. In this context, rubber-based agroforestry system (RAS) with rubber clonal material and efficient management practices appears as a more sustainable alternative. However, the resilience of these systems are facing socio-economic (volatility of NR price) and environmental (climate change, erosion of biodiversity) issues. Conventional breeding programmes are devoted to monospecific system. Researchers are confronted to biological and environmental constraints such as the long-term breeding cycle for perennial crops, and the adaptation to accelerating climate change. CIRAD has initiated a long-term collaboration with IRRI, and more recently with UGM, to develop a comprehensive analysis of latex production and defence to abiotic and biotic stress using omics and genetics approaches. The proposal aims at strengthening and structuring the current projects as well as implementing a participatory breeding programme in Indonesia in order to design resilient rubber cropping systems with adapted planting material to a fast changing socio-economy and environment conditions. The proposal will be organized in four workpackages (WP). First, varietal and cropping system ideotypes adapted to smallholders will be co-constructed through a participatory process. The typology of smallholders and the needs of the rubber commodity chain stakeholders including the expectations of policy makers and replanting governmental agencies will be identified. The second WP will focus on the understanding and modelling the performances of Rubber-based Agroforestry Systems in contrasting environments. Third, the predictive value of *Hevea* genetic resources in Indonesia will be determined through the collection and modelling of data from the characterized germplasm and the deep phenotyping of a segregating population in a small-scale clone trial using physiological and technological analyses as well as molecular genetic tools. The fourth WP will coordinate the activities and integrate the multidisciplinary data in order to determine theoretical experimental design, replanting packages and to develop a data collection system for further in-farm large-scale trials. Consequently, the existing scientific consortium gathering different disciplines will be strengthened with socio-economic studies in order to survey and model the evolution of agro-systems as well as to breed for rubber-based agroforestry systems.

Keywords : Rubber, Plant breeding, Participatory research, Agroforestry, Indonesia, *Hevea brasiliensis*, Rubber, Food crop

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Flagship project : no

Project leader : Pascal Montoro

Project leader's institution : CIRAD

Project leader's RU : AGAP

Budget allocated : 230000 €

Total budget allocated (including co-financing) : 230000 €

Funding : Labex

GOAL

The ambition of the project is to contribute to the adaptation to climate change of Indonesian rubber smallholders. In that respect, the project aims at developing a participatory breeding process in Indonesia to design resilient rubber cropping systems for smallholders with planting material adapted to fast-changing socioeconomic and environmental conditions. An existing scientific consortium on plant genetics and breeding will be strengthened by integrating socio-economics and experts on agroecology to survey and model the evolution of agro-systems as well as to breed for rubber-based agroforestry systems. A participatory approach with all stakeholders will guarantee the co-construction of solutions and will facilitate the future support of national and local authorities by funding replanting programme with climate-smart packages for smallholders.

ACTION

The project supports a long-term programme aiming at Initiative in the participatory breeding scheme for resilient rubber cultivation systems for smallholders in a context of global change. This programme should include a process of reiteration of scientific questions and agriculture-based solutions to respond to fast-changing socio-economic and environmental constraints. The capitalisation of the multidisciplinary and participatory studies will be beneficial to the implementation of in-farm evaluation trials. Ultimately, the feedback from in-farm evaluation trials should lead to adjustment for a better resilience of the system.

the project is structured in 4 Workpages :

WP 1 : Co-construction of varietal and cropping system ideotypes adapted to smallholders.

This first action aims designing solutions with stakeholders by integrating socio-economic data to design a new rubber breeding strategy for innovative agro-ecological systems. This WP will be implemented for 1.5 years.

WP2: Understanding and modelling the performances of rubber-based agroforestry systems in contrasting environments.

Rubber agroforestry systems (RAS) are usually presented as more resilient than monospecific plantation to climate change due to improved ecosystem functions (water circulation, nutrient availability, biological control of pests etc...). However, the resilience of RAS depends on the sharing of resources (light, water, nutrient) between the rubber trees and the associated species. In particular, water can become a major limiting factor. This WP aims at 1/ characterizing the abiotic and biotic constraints on the performances of RAS in terms of productivity and provision of regulating ecosystem services, 2/ identifying the ecophysiological traits to be targeted by breeding programs

WP3: Determination of the predictive value of Hevea genetic resources in Indonesia.

The objective of this WP is to class the rubber clones according to their agronomic and physiologic capacities in order to facilitate the selection of material for further in-farm large- scale trials, which will be established after the present project.

WP4 : Data integration .

The aim of this WS will be to interpret the demand of stakeholders, describe the impact of local socio-economy and environment on the pattern of rubber plantations, and determine the rubber clone and cropping system ideotypes for further large-scale trial. Two sessions will be organized to establish the theoretical design of replanting packages (rubber genotypes, intercrop species and varieties, agronomic practices), theoretical statistcal design for in-farm large-scale trials, and specifications for in-farm data collection.