

ATSAF Academy Academy for International Agricultural Research for Development

Junior Scientists Tandems Final Report

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Title: SYNERGIZING AGROECOLOGICAL TRANSITION AND THE WEFE NEXUS: A FARM-LEVEL MODELING APPROACH FOR SUSTAINABLE AGRI-FOOD SYSTEMS IN MOROCCO

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To begin with, I would like to express my deepest gratitude to ATSAF, Deutsche Zusammenarbeit, and GIZ for funding my participation in the Junior Scientist Tandem (JST) program, which enabled my six-month internship at ICARDA Morocco. My heartfelt thanks go to Dr. Charles Kleinermann, my supervisors at ICARDA for mentorship and guidance, and to Prof. Dr. Hatem Belhouchette from CIHEAM-Montpellier and Prof. Dr Echchgadda Ghizlan from École Nationale d'Agriculture de Meknès (ENAM) for their collaboration. I am indebted to the farmers of the Fès-Meknès region in Morocco for sharing their wisdom and trust, and to the University of Hohenheim for integrating this opportunity into my academic journey. This experience has been a cornerstone of my growth as a researcher committed to equitable agricultural development.

As part of my internship with ICARDA in Morocco, in collaboration with CIHEAM-Montpellier and ENAM, I had the opportunity to contribute to the NATAE project (North African Transition to Agro-Ecology). This project aims to promote a shift towards agroecological practices among farmers in North Africa, encouraging more sustainable, climate-resilient agricultural systems. My involvement focused not only on the technical aspects of the project but also on fostering intercultural dialogue and scientific cooperation across institutions. Working within this international framework provided me with valuable exposure to multidisciplinary approaches and innovative strategies for sustainable development. This report provides a comprehensive overview of my activities during the internship, highlights key outcomes, and reflects on how the experience shaped my academic growth and future career ambitions.

The NATAE project's initial phase prioritized understanding the heterogeneity of farming systems in different living labs in North Africa, recognizing that a one-size-fits-all approach to agroecology would fall short in the region's diverse ecological and socio-economic landscapes. In Morocco's Skoura M'daz region, the team began with a two-stage, mixed-methods framework to classify farm types. During the first stage, agricultural experts, extension officers, and community leaders collaboratively developed a preliminary farm typology based on irrigation methods, crop diversity, landholding sizes, and socio-economic indicators. This participatory process yielded five provisional farm categories, ranging from smallholder rainfed



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cereal growers to larger-scale irrigated date-palm producers, establishing a baseline for empirical validation.

Then during the second stage, and in order to anchor this expert-driven typology in field-level realities. Field surveys with 30 farmers across Skoura M'daz's agroecological zones were conducted, gathering data on household demographics, production systems, water management practices, and economic constraints. Structured interviews were complemented by participatory field visits, where direct observations of irrigation infrastructure and cropping patterns enriched the understanding of farmers' adaptive strategies to climate variability. This iterative process revealed discrepancies between the initial classifications and the complex dynamics on the ground. For instance, many "smallholders" relied on off-farm income sources, challenging the accuracy of land-size-based categories. Through integrated analysis of both quantitative data and qualitative insights, the typology was refined into three distinct farm types (figure 1) shaped primarily by water access, market integration, and levels of risk tolerance.

To validate these findings, I returned to Skoura M'daz in December 2024, as part of my internship, for follow-up visits. These second-round interviews allowed me to verify preliminary conclusions, collect updated economic data, and reassess the evolving challenges faced by the farms—particularly the shift toward drought resilience practices due to declining precipitations and groundwater levels. On-site verification helped clarify key ambiguities, such as understanding the distribution of farms according to their farm activity and the inequality in access to water and more.

In addition to the assessment of the farm typology, I collected detailed economic data necessary for developing a bioeconomic model that serves two core purposes in developing my linear programming model: first, to simulate a baseline scenario representing the current economic viability of conventional practices, which I developed using GAMS in collaboration with a team of PhD students from CIHEAM; and second, to enable comparison with alternative scenarios involving the adoption of agroecological techniques. This model aims to identify pathways toward more profitable and sustainable farming systems by quantifying trade-offs and synergies with the WEFE Nexus project's principles.

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Beyond the academic and technical aspects, this internship was an invaluable opportunity to work within a truly international research environment. Collaborating with researchers from ICARDA, CIHEAM-Montpellier, and ENAM exposed me to diverse scientific perspectives and enriched my ability to navigate multicultural teamwork—an essential skill in today's global research landscape. At the same time, engaging closely with Moroccan farmers on the ground was a heartwarming and grounding experience. Having spent recent years in Germany, this return to my roots allowed me to reconnect with the cultural rhythms of rural Morocco, blending my scientific training with a renewed sense of local belonging. One of the unexpected challenges I encountered was linguistic: many agricultural terms I had learned in English or French were unfamiliar in Arabic, making some conversations initially tricky. However, the warmth, hospitality, and patience of the farmers quickly bridged those gaps. Their openness to dialogue and their deep awareness of climate change impacts were inspiring, as was their willingness to collaborate in shaping a more sustainable future for their land. This blend of intercultural academic exchange and grassroots connection made the experience both professionally rewarding and personally meaningful.

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Visual Highlights of the Internship Experience

