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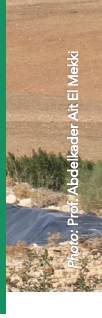

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Climate Change, Transformative Adaptation Options, Multiscale Polycentric Governance, and Rural Welfare in Oum Er-Rbia River Basin, Morocco: Policy Recommendations

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Summary

- This policy report is based on an analysis that delineates possible impacts pathways characterized by various configurations of climatic, economic, policy, technical, institutional, infrastructural, and welfare-related variables through which climate change's impacts are transmitted ultimately on rural welfare at the grassroots level.
- The analytical framework provides an excellent operational context for evaluating the roles of Multiscale Polycentric Governance (MPG) in mediating and enhancing the climate resilience impacts of Transformative Adaptation Options (TAOs) both across regional scales and sectoral contexts.
- Empirical application of the framework to Morocco's Beni Mellal region in the Oum Er-Rbia Basin shows linkages and synergies of TAOs and governance components that enhance the effectiveness of TAOs.
- Transition to effective forms of governance through institutional improvements can help the existing water institutions in the basin which are under extreme pressure due to the challenges of climate change.

Scope and Objectives of the Study

Recurrent droughts negatively affect Moroccan agriculture and food sectors. According to the "White Paper" published by the Water (Group, 2022) Morocco's water resources have experienced a remarkable decline in recent decades due to the drop in rainfall, overexploitation of nonrenewable water resources, lack of development programs, coherence, and significant governance deficit. Most forecasts show that the country will gradually show signs of increasing aridity over the next few decades due to rising temperatures and decreasing rainfall (Harbouze et al., 2019). The World Resources Institute (WRI) places Morocco among the "extremely risky" countries for water stress (20th out of 167 countries). The impact on water resources will likely be very significant in the future, and the adequacy of water resources for agricultural development has become a more important question than ever before.

The current Minister of Agriculture, Maritime Fisheries, Rural Development, and Water and Forests, and the former Delegate of Morocco, Vice-President of the International Center for Advanced Mediterranean Agronomic Studies (CIHEAM), indicated that due to climatic constraints, in particular the scarcity of water resources which has become structural in the Mediterranean, "projections on water stress in the riparian countries are unfavorable, with estimates which predict a contraction in GDP of 6% by 2050 alone due to water scarcity" (Similarly & Sadiki, 2017)

In this context, the International Water Management Institute (IWMI) has conducted a research study aiming at "***developing a conceptual and operational understanding of multiscale polycentric governance (MPG) structure based on intrinsic functional connections among institutions, infrastructures, and governance using institutional economics definitions, terminologies, and stylized facts***" in Morocco (Saleth et al., 2023). This study forms part of the research under Work Package #4 (WP4) of CGIAR Research Program: Building Systemic Resilience against Climate Variability and Extremes (ClimBeR), which has the overarching goal of "***setting up a bottom-up polycentric governance framework for promoting multiscale transformative adaptation options (TAO) and targeted climate investments***".

The Saleth et al. (2023) study has developed and empirically applied an innovative methodology, which is rooted in an analytical framework that delineates various possible pathways through which climate change's impacts are transmitted ultimately on rural welfare at the grassroots level. Since these impact pathways are characterized by various configurations of climatic, economic, policy, technical, institutional, infrastructural, and welfare-related variables, they provide an excellent operational context not only for incorporating various elements of the MPG structure within a unified context but also for evaluating their roles in mediating and enhancing the climate resilience impacts of TAOs both across regional scales and sectoral contexts.

The Oum Er-Rbia Basin in Morocco was selected as an empirical context for piloting the study, demonstrating its practical application, and evaluating its methodology. The study basin and the sample country were selected keeping in mind the requirements of the study's main objectives. Given the vast size of the study basin, there is a need to delineate a study region that is representative enough to capture the overall basin characteristics and manageable enough from a logistics perspective. The Oum Er-Rbia basin covers—either fully or parts of—three major regions in Morocco, i.e., Beni Mellal-Khenifra, Casablanca-Settat, and Marrakesh-Safi. Since the Beni Mellal-Khenifra region has the major share of agricultural areas within the basin, this region, covering five provinces: i.e., Azilal, Beni Mellal, Fquih Ben Salah, Khenifra, and Khouribga, is selected as the study region. The brief field visit was undertaken to interact with different stakeholder groups and have a first-hand experience with major issues and challenges facing the study basin. However, the sample selection and data collection cover all regional scales and sectoral contexts, going beyond the study region per se.

Similarly, the identification of the candidate TAOs and the key elements of the prevalent MPG structure and impact transmission pathways are based on national, regional, basin, and sectoral level reviews, relying on both policy documents and published literature as well as on interactions with experts, policymakers, and officials. In any case, all these aspects are essential to develop the analytical framework that reflects the realities of the study region in particular, and the study basin in general.

This report stresses key governance-related policy recommendations based on the results of Saleth et al., (2023). The following section presents the evaluation methodology applied in this study, and the subsequent section highlights the main policy implications.

Evaluation Methodology

The evaluation methodology has three components: (a) analytical framework, (b) mathematical model, and (c) empirical approach. The basic building blocks of the analytical framework are impact pathways and their underlying chains of variables. As to the content of the analytical framework that is to be empirically applied in the context of the study region, besides the trigger element of climate change and the ultimate impact variable or policy goal of rural welfare, it covers three sectors, three sets each of TAOs and MPG structure elements, and several impact or


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impact transmission variables. The three sectors are water, agriculture, and water supply. However, other sectors, such as livestock and rural non-farm enterprises are covered implicitly as part of the impact variables. The three TAOs are (a) contract farming and public-private partnership in agriculture, (b) crop shift towards tree and high-value crops, (c) and drip system conversion and irrigation modernization.

The MPG structure is represented by three groups, i.e., institutions (laws, policies, and organizations), infrastructure (water, agriculture, and environment), and players (the state, corporate sector, service providers, and civil society organizations) operating across regional scales and sectoral contexts. The three governance elements are, in turn, represented by a total of 20 institutional, infrastructural, and player-related variables. The impact or impact transmission variables mostly relate to production, productivity, cost, and income-related aspects; 24 variables represent these aspects.

Thus, taken together, the analytical framework captures the structural linkages and interactive effects of 52 variables. The different configurations of these variables characterize various possible pathways linking climate impact and social welfare.

The mathematical model has a close link with the analytical framework of CC-TAO-MPG-RW. This is because tracing all possible impact pathways and defining each of the 52 variables can translate the analytical framework into a mathematical model with a set of 40 sequentially and simultaneously interlinked equations. These equations, which are defined by different configurations of variables, characterize, in fact, most of the important layers operating in the process of CC-TAO-MPG-RW interactions in the study basin. The analytical framework and its mathematical representation constitute only two components of the evaluation methodology. The other, but more important, component relates to the empirical approach used to generate data needed for the numerical estimation of the mathematical model involving a system of sequentially and simultaneously linked equations.

The empirical approach involves major challenges as most of 52 variables are inherently ex-ante. Observed data on them are either absent or irrelevant as such data remains static, outdated, and devoid of any expectational considerations. The empirical approach underlying the evaluation methodology is trying to elicit valuable information from a suitable sample of stakeholders using a well-designed questionnaire. While the stakeholder-based survey provides flexibility in conceptualizing, defining, and selecting more appropriate and specialized variables, the perception-based data allows a synthesis of objective, subjective, and aspiration-related factors and incorporates both the ex-ante and dynamic elements into the reckoning. Moreover, perception-based data has a solid theoretical legitimacy, and their reliance on empirical application and policy analysis also has a long tradition.

To collect the needed data, the questionnaire was administered to a purposively selected sample of 176 respondents dispersed within (the Beni Mellal – Khenifra Region) and outside (the

Central Departments) of the study basin and having diverse characteristics and backgrounds. The questionnaire is structured into three parts, namely the trigger variable, which is the climate change impact; the sectoral impacts variables (3); the TAO variables (3); the institutional (MPG element) variables (20); the impact transmission variables (24), and the development goal variable, which stands for rural welfare.

Key Policy Implications

In Morocco, mitigating the effects of climate change (with recurrent droughts) on agriculture, food security, and rural welfare is a leading priority for the Ministry of Agriculture as per the agricultural strategies initiated in 2008 for objectives to be achieved in 2030 (Green Morocco Plan 2008-2020, Green Generation Strategy 2020-2030). By referring to the empirical approach of the study, we present the most important policy recommendations that could improve the effectiveness of adopted TAOs, MPG system, resources, and production resilience, taking these objectives into account.

TAOs reinforcement

The study's results illustrate the linkages and synergies among the selected TAOs. For instance, the extent and effectiveness of crop shift towards tree and high-value crops are positively affected by the other two TAOs related to contract farming and public-private partnership in agriculture and drip system conversion and irrigation modernization, respectively. Moreover, the effectiveness and impacts of drip system conversion and irrigation modernization - a key TAO in irrigated areas - are positively linked with a better performing agricultural sector and water institutional arrangements as well as a facilitative land tenure system, especially the landholding pattern in large irrigation perimeters. The results also show that crop pattern in crop diversity is favorably influenced by increasing cultivated area, crop shifts towards tree and high-value crops, drip system conversion and irrigation modernization, and land and soil quality. All TAO linkages and effectiveness are significantly impacted by the relevance of the domestic agricultural marketing regime and the importance of the corporate sector.

Consequently, the effectiveness and impacts of the TAOs involving contract farming, public-private partnership, and drip irrigation could be improved by setting up and/or reinforcing the following policy changes:

- Establish a facilitative land tenure system (including the landholding pattern in large irrigation perimeters), allowing long-term land leases from government or rural communities, along with better-performing water institutions and encouraging credit policies for investment. Such a coherent measure taking this policy package is necessary for making crop pattern shift as an ineffective option of transformative adaptation,

- Encourage more extensive involvement of the corporate farming sector through favorable external trade regimes, conducive subsidy and tax policies, and successful contract farming and public-private partnerships. The underlying reason is that corporate farming is essentially oriented towards export and domestic niche markets of high-value crops,

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- Further encourage the relevant activity of service providers through the facilitation of administrative procedures that are compulsory before the farmer benefits from the drip irrigation subsidy system,

- Rehabilitate the prevailing water-related infrastructures, especially those related to water conveyance and delivery systems, because their constraints tend to reduce the expansion and effectiveness of the TAO of drip system conversion and irrigation modernization, and

- Reinforce the favorable effects of the TAO related to crop pattern shift in cultivated areas. In the meantime, the unfavorable effect of TAO involving contract farming and public-private partnerships is rather unexpected. It requires further investigation into the factors leading to such a counter-intuitive effect.

MPG improvement

Climate change tends to create potential pressure for additional investment in improved maintenance of water infrastructure. Meanwhile, climate investments are positively influenced not only by climate change impact but also by government institutions—especially those operating in agricultural and environmental sectors—and donor agencies and international investors. With customary institutions, they dominate the overall performance of water institutions and water infrastructure. Notably, government institutions play a more dominant role.

Furthermore, the main factors having a favorable impact on the overall performance of the agricultural sector are a better availability of water, an efficient climate information system, and facilitative land tenure conditions. The results suggest that though customs and traditions remain as constraints, the performance of agricultural production and marketing cooperatives is influenced by the positive support from various kinds of rural service providers as well as agricultural credit and investment agencies.

As for household water consumption, water security is as important as income and food security, given that water is a critical component of the basic needs dimension of rural welfare. The level of water security is positively influenced by better water supply for household consumption and more effective water institutions. This is consistent with the favorable effects of adequate allocations for meeting basic water needs and institutional norms that guarantee basic need-based water allocation. However, while climate change's negative effects on water security are highlighted by the study's investigations, which is consistent with our expectations, results suggest a declining significance of customary institutions in ensuring household water security.

Without substantial investment and significant improvement, existing water institutions in the study basin are under extreme stress due to the challenges of climate change. This means that they must urgently adapt themselves to a compelling climate condition that requires several adjustments, including the transition to effective forms of governance through institutional improvements that have to be designed, notably to:

- Develop the positive relationship observed between agricultural credit and investment institutions and supportive agricultural and environmental institutions, favorable donor and international investments, and proactive corporate sector as it illustrates the strategic need to reinforce the linkages within the MPG structure. Notably, the corporate sector, as a linkage variable, brings the positive impact flows captured from other pathways between institutions,

- Promote the growth of rural service providers in the study basin by strengthening and reorienting state taxation policies and agricultural credit institutions, two weak MPG elements that have somewhat an unfavorable/insufficient role,

- Improve the effectiveness and impact of agricultural research and extension systems through solid linkages with the proactive corporate sector, efficient climate information system, and supportive agricultural and environmental institutions,

- Strengthen the effectiveness and performance of agricultural value chain networks as the role of agricultural credit and investment institutions, marketing cooperatives, export-oriented trade regimes, and a strong network of rural service providers positively influences them, and

- Reinforce the positive effects of an effective domestic agricultural market regime and favorable subsidy and taxation policies by counter-balancing the negative effects of the less integrated export trade regime and weak agricultural and food price policies.

Enhancement of resources and production system resilience

The major factors positively influencing water productivity are land and soil quality, crop pattern, land productivity, and water institutions. Results also show that the food production level is favorably influenced by expanding cultivated areas, higher land and water productivity levels, and a supportive network of rural service providers. Understandably, the most dominant factor that favorably affects the level of labor productivity is land productivity. All of these factors are link variables that impact rural households' welfare.

Besides, the production system based on larger farm sizes and oriented toward domestic and international markets tends to promote crop specialization. However, crop specialization, though good for productivity, scale economy, and value chain development, tends to expose the production systems to climatic risks and uncertainties. As for livestock production in the study basin, the feed and fodder supply level is positively affected by crop patterns with diverse cropping systems, especially the mixed farming system, and higher industrial and commercial crop production levels.

Regarding the level of food prices, the factor determining the demand side of food security, the two interrelated factors, i.e., food availability and food production, have positive effects. This result seems counter-intuitive as the food price levels are expected to decline with higher food production and availability. However, suppose one considers the reverse side of the two-way flow of impacts. In that case, the result is consistent because higher food prices enhance both food production and availability. This insight underlines the need to consider the two-way nature of impact flows with both forward and reverse feedback in many contexts.

Interestingly, results also show that the three main factors affecting rural wage levels are labor productivity, employment level in the rural non-farm sector, and production systems oriented to industrial and commercial crops. The level of rural jobs is favorably affected by industrial and commercial crop production systems, rural wage levels, and crop and employment insurance schemes. The positive effect of the industrial and commercial crop production system on rural employment is consistent with its negative effect on rural wages.

Based on these interesting factors and production results, and in addition to policy changes that can be addressed on TAOs and MPG instruments, farm resilience to climate change in the selected research field could be improved by targeting actions that aim to:

- Enhance the production levels of industrial and commercial crops by taking profit from the positive effects of export and niche markets, on the one hand, and improve water productivity from efficient water use as achieved mainly through dependable irrigation and advanced water and irrigation technologies, on the other hand,

- Develop livestock production, in particular, and the livestock sector, in general, using the most dominant and favorable factors, notably diverse livestock composition, favorable domestic market regime, and expanding corporate investment. In addition, given the fact that, with their predominant orientation towards the crop sector, agricultural credit and investment institutions have to play a more sufficient and influential role in supporting the livestock sector,

- Enhance water availability for agriculture by improving water institutions' effectiveness, especially those related to | inter-sectoral allocation. The insignificant and unexpected effects of drip system conversion and irrigation modernization, and the technical option of the climatic information system suggests the need to investigate the missing or unfavorable conditions that limit expected impacts,

- Reverse the lackluster role of agricultural food price policies, agricultural credit and investment institutions, and contract farming, which seem to have either a weak or unfavorable effect on food production. Nevertheless, the reasons behind such an impact of these factors require further and more focused investigation,

- Encourage robust domestic agricultural market regime coupled with effective subsidy and taxation policies that tend to improve the level and effectiveness of the overall market prices of agricultural products with their positive consequences on food supply, and

- Support Research and Extension institutions to enhance water, land, and labor productivity.

Finally, rural welfare at the household level, the ultimate policy goal that captures the impact flows across all pathways in the system, depends on the factors representing the roles of income-related factors, food consumption-related aspects, and water as basic needs. Indeed, the results show that farm income, food availability, and water security directly and favorably affect rural welfare at the household level. However, as expected, the same has an inverse or unfavorable relationship with the level of labor income and food prices. Notably, the welfare implications of food prices are universal

because they affect all households. Those associated with labor income are specific only to non-farming households, which rely exclusively on wage income employment and income from other non-crop sectors such as livestock and rural non-farm activities. It is these or similar households that are particularly vulnerable to the unfavorable welfare effects of climate change in the study region.

The Green Generation strategy (2020 – 2030) offers a pioneering example of supporting farmers in terms of food security and economic growth. However, in the absence of effective involvement and commitment of rural populations, the results obtained following policy design are generally disappointing. Consequently, policy implications resulting from this Climate Change – Transformative Adaptation Options – Multiscale Polycentric Governance – Rural Welfare (CC – TAO – MPG – RW) study of the IWMI/ClimBeR research program, need to be shared with all of the study partners, including farmers and their organizations. The objective is to collect their opinions about the relevance and feasibility of the suggested policy insights for possible implementation in the context of climate change adaptation in the Oum Er-Rbia basin and benefiting from its economic advantages.

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