# Conditions for Sustainable Development of Small-scale Rice Irrigation and Its Impacts on Local Livelihoods in Southern Ghana

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## Abstract

Rice production in Sub-Saharan Africa (SSA) has been outstripped by soaring demand due to rapid population growth and urbanization. As a promising strategy for bridging this gap, efforts have been geared toward introducing small-scale rice irrigation (SSRI) in rainfed lowlands. Though SSRI is considered viable and promising in SSA, it is unclear how and to what extent this technology is adopted and sustained by local farmers. Mechanisms behind such realities also remain unclear. Though studies found several conditions critical for SSRI adoption and sustainment, the findings are often ambiguous due to methodological issues. Reports on the impact of SSRI might also be questioned. Though many researchers reported yield improvement in SSRI, this is not evidenced by the farmer's experience. Furthermore, few evaluated the impacts of SSRI on farmer's profitability, labor use, food supply, and property, which constitute their basic livelihood needs. In this context, the objectives of this research are to disclose the realities of SSRI adoption and sustainment, explore its mechanisms, and perform a comprehensive impact assessment on local livelihood.

To address the objectives, a case study method is primarily utilized in this research. It diagnoses the current modes of agriculture and rice production with a focus on Ghana, in order to select the applicable sites for a case study. Based on the current modes of agriculture and rice production in Ghana, study sites were selected in Ahafo Ano South district (Ashanti region), which consist of inland valleys suitable for SSRI and enable its active promotion by projects. After selection of the study sites, local rice farmers including project participants and non-participants were exhaustively sampled via a semi-structured questionnaire and together with accurate field observation and measurement, a substantive data set was obtained for further analyses.

Characteristics of local rice farmers and their behaviors toward SSRI projects were first analyzed to yield insights into requirements and issues regarding SSRI adoption and sustainment. Covering these requirements and issues, the possible decisive factors for SSRI adoption and sustainment are analyzed to explore the respective mechanisms. Time series statistics were used to obtain an overall view of SSRI sustainment for the project participants. In addition, the underlying factors for sustainment were examined with a focus on three conditions (land security, mechanization, and collective action), which are deemed orthodoxies in the literature and which are encouraged in SSRI projects. To understand how and to what extent adoption of SSRI flows from the projects, adoption patterns among participants and non-participants are contrasted using quantitative and qualitative indicators. The former indicator refers to the number of the adopted

technologies, while the latter refers to necessary maintenance. To explore the mechanisms behind these different patterns of SSRI adoption, the underlying factors are analyzed with a focus on external factors, farmers' and farm characteristics, which were screened and adopted for estimation models. Finally, the impacts of SSRI are assessed using comparative analyses of different adoption patterns, which gauge the effects on yield, labor use, profitability, food supply, and property.

Analyses of local farmers' characteristics and behaviors toward SSRI projects produced marked results with regard to requirements for SSRI adoption (e.g. asset accumulation) and constraints to its sustainment (e.g. collective action). The time-series statistics for project participation indicate that SSRI is poorly sustained in practice. Results of the factor analyses suggest securing land tenure and mechanization contributes little to SSRI sustainment, while collective action is proved adverse to its facilitation. It was also found that SSRI is poorly disseminated in the study sites. The quality of adoption is also poor, with some of the adopters bypassing the required facility maintenance. Estimation results of multinomial logit models indicate that development intervention, asset holding, water reliability, and farm accessibility, among others, account for different patterns of SSRI adoption. Its impact assessment further reveals that what improves yield substantially is limited to the specific adoption pattern that matches the required facility maintenance. In terms of profitability, however, specific adoption patterns hold no significant advantage over non-adoption due to capital intensification. The impact assessment also reveals that SSRI is not favorable in terms of securing farmer's food supply and land property; the introduction of SSRI limits food supplies by making it difficult for farmers to grow major food crops, and provides limited opportunity for them to secure land property, which is conventionally endorsed for the production of cash crops other than rice.

The findings from this study suggest that SSRI could be adopted and sustained more extensively by individual field management, asset accumulation, ready water and farm access, and judicious development intervention. However, the positive and significant impact of SSRI on local livelihoods is not promising. Therefore, the related technical promotion should be devised to reflect an approach built more on local needs and contexts. Further research is also required. The methods to collect and treat data, in particular, should be reexamined because previous findings, which are at odds with the results of this research, possibly stem from limited care about these basic issues.