



Government Policies and Sustainable Agriculture at the Nasho Irrigation Project, Rwanda

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Abstract: This study assessed the influence of government policies on sustainable agriculture at the Nasho Irrigation Project in Kirehe District, Rwanda. A quantitative, cross-sectional correlational design was used. The target population was 150 farmers, extension agents, energy policymakers, government entities and project implementers, from which a stratified random sample of 109 was drawn using Yamane's formula. Structured questionnaires measured policy support, financial incentives, support programs and promotion initiatives on a five-point scale, and 106 were returned (97.2%). The instrument was reliable (Cronbach's $\alpha = 0.916$), and data were analyzed in SPSS using descriptive statistics, Pearson correlation and multiple regression. Respondents agreed moderately that government interventions encourage solar irrigation (means 3.19 to 3.35). Government policies correlated strongly with sustainable agriculture ($r = 0.740$, $p < 0.01$) and had a positive, statistically significant effect in the joint model ($\beta = 0.178$, $p = 0.036$), which explained 73.4% of the variance. The effect of policy was smaller than that of extension services and technology awareness. The study concludes that supportive policy is a necessary but insufficient enabling condition. It recommends expanded subsidies, low-interest credit, demonstration farms and regular monitoring, delivered together with extension and awareness programs.

Keywords: Policy, Irrigation, Agriculture, Sustainability, Adoption, Solar, Rwanda

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1. Introduction

Sustainable agriculture is essential for food security, rural livelihoods and environmental protection, and the adoption of improved agricultural technology is widely regarded as a central route to achieving it (Arslan et al., 2022). Among available options, solar-energy irrigation stands out for countries with limited access to dependable electricity. Zemadim et al. (2023) maintain that it allows year-round cropping, lower operating costs, better water-use efficiency and stronger resilience to climate variability. Despite these advantages, uptake across Sub-Saharan Africa remains limited by high investment costs, restricted access to affordable finance, weak institutional support and inconsistent policy implementation (Durga et al., 2024).

Rwanda reflects both the opportunity and the difficulty. Agriculture employs about 65% of the workforce and contributes over 31% of gross domestic product (National Institute of Statistics of Rwanda, 2023), yet production remains largely rain-fed. Only about 11.33% of the country's estimated 66,840.5 hectares of irrigation potential has been developed (Mukeshimana et al., 2022). The Government of Rwanda has responded through the Small-Scale Irrigation Technology program, the National Irrigation Master Plan and the Strategic Plan for Agriculture Transformation (Ministry of Agriculture and Animal Resources, 2018) and has promoted solar irrigation as part of its green growth agenda.

The Nasho Irrigation Project in Kirehe District is a flagship result of these efforts. It is a \$54 million partnership between the Government of Rwanda and the Howard G. Buffett Foundation that installed 63 center-pivot systems,

powered by a 3.3 MW solar plant, over about 1,173 hectares serving 2,099 smallholder farmers in the Nasho Irrigation Cooperative (Ministry of Agriculture and Animal Resources, 2020). Even so, adoption and operational use among cooperative farmers have stayed below expectations, and field assessments point to maintenance problems, reactive water governance and limited technical capacity (Ikundabayo et al., 2026). Local implementation of supportive irrigation policy has also lacked uniform enforcement, leaving institutional gaps at cooperative level.

Earlier research has mostly examined irrigation technologies in general, relied on evidence from countries whose institutions differ from Rwanda's, and seldom considered specific policy dimensions inside a large, centrally managed solar irrigation scheme. No empirical evidence existed on how policy support, financial incentives, government support programs and promotion initiatives relate to sustainable agriculture at Nasho. Such evidence is needed to protect a very large public investment and to guide policymakers and development partners.

The purpose of this study is therefore to assess the influence of government policies on sustainable agriculture at the Nasho Irrigation Project. It is guided by the following research question: *What is the influence of government policies on sustainable agriculture at the Nasho Irrigation Project?* The article draws on a wider study that also examined extension services and technology awareness; these are used here as statistical controls.

2. Literature Review

Government policies shape the institutional, financial and regulatory setting in which farmers decide whether to adopt technology. Incentives, in particular, motivate adoption of sustainable practices and improve the competitiveness of the agricultural sector (Piñeiro et al., 2020). For solar irrigation, supportive policy can lower financial barriers, ease access to equipment and strengthen institutional backing. In terms of technology acceptance theory, such measures act as facilitating conditions, raising farmers' perceived control over adoption.

In the Philippines, Agaton and Guno (2024) found that solar irrigation raised productivity, cut energy costs and improved climate resilience, but that adoption was limited by high upfront costs, low confidence in the technology and limited knowledge. They argue that policy should combine

financial incentives with farmer education, institutional support and technical assistance. Similarly, Sanogo et al. (2025) report that subsidies, membership of rural organizations and institutional support significantly increased adoption of solar pumps among smallholders in Burkina Faso, although high equipment costs remained a major obstacle. Evidence from China also associates supportive policy and incentive systems with technology adoption and more sustainable agricultural development (Huang & Wang, 2024).

Ngango and Hong (2021) studied 360 farming households in Rwanda and found that awareness of government subsidy programs, access to extension, access to credit and reliable water sources significantly raised the likelihood of adopting small-scale irrigation, which in turn improved land productivity. Their work shows that policy can influence agricultural outcomes, but it concerns small-scale irrigation in general and does not address large solar-powered schemes such as Nasho.

The studies agree that policy matters but differ on which instruments matter most, which suggests that effectiveness depends on the local institutional and socioeconomic context. This article tests that proposition for Nasho by relating four policy dimensions (policy support, financial incentives, government support programs and promotion initiatives) to sustainable agriculture, measured through crop yields, water-use efficiency and resilience to climate shocks.

3. Methodology

3.1 Research design

The study used a quantitative, cross-sectional correlational design. This design allows the direction, strength and significance of relationships to be estimated without manipulating any variable, although findings are read as associations rather than proof of cause and effect.

3.2 Population and sampling procedures

The target population was 150 stakeholders in the Nasho Irrigation Project. Because these groups play different roles in adoption, the population was divided into five strata and a sample of 109 was calculated with Yamane's formula at 95% confidence ($n = 150 / (1 + 150 \times 0.05^2)$). Respondents were then selected at random within each stratum (Table 1).

Table 1: Target Population and Sample by Stratum

Stratum	Population	Sample
Farmers	73	53
Extension agents	25	18
Energy policymakers	21	15
Government entities	5	4
Project implementers	26	19
Total	150	109

3.3 Instrument, validity and reliability

Data were collected with a structured questionnaire built from the conceptual framework and adapted from earlier empirical studies. Government policies were measured with four items covering policy support, financial incentives, government support programs and promotion initiatives. Sustainable agriculture was measured with three items on crop yields, water-use efficiency and resilience to climate shocks. All items used a five-point Likert scale (1 = strongly disagree, 5 = strongly agree).

Content validity was established by matching items to the objectives, research question and conceptual framework, with expert review and a pilot test before the main survey. Construct validity was also assessed. Internal consistency was high: Cronbach's alpha was 0.916 for government policies and 0.930 for sustainable agriculture, well above the 0.70 threshold (Ahmad et al., 2024).

3.4 Data analysis

Data were analyzed in SPSS. Descriptive statistics (means and standard deviations) summarized perceptions, Pearson's correlation measured the association between policy and sustainable agriculture, and multiple regression estimated the effect of policy while controlling for extension services and technology awareness. The model was:

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + e$$

where Y is sustainable agriculture, X1 government policies, X2 extension services and X3 technology awareness. Participation was voluntary and anonymous, and permission and ethical clearance were obtained before fieldwork.

4. Results and Discussion

The results are organized around the research question: *What is the influence of government policies on sustainable agriculture at the Nasho Irrigation Project?*

4.1 Response rate and diagnostic checks

Of the 109 questionnaires distributed, 106 were returned usable, a response rate of 97.2%. Diagnostic checks supported regression analysis: residuals were approximately normal, tolerance values (0.358 to 0.413) and variance inflation factors (2.423 to 2.790) showed no problematic multicollinearity, the residual plot showed no heteroskedasticity, and the Durbin-Watson statistic (1.973) showed no autocorrelation.

4.2 Perceptions of government policies

Respondents agreed moderately that government interventions encourage adoption of solar-energy irrigation at Nasho (Table 2). Support programs were rated highest and financial incentives lowest.

Table 2: Perceptions of Government Policies

Indicator	Mean	SD
Government support programs improve farmers' access to solar-energy irrigation	3.35	1.163
Government policies encourage farmers to adopt solar-energy irrigation	3.24	1.159
Government initiatives promote the use of solar-energy irrigation	3.23	1.089
Government financial incentives encourage farmers to adopt solar-energy irrigation	3.19	1.139

Five-point scale (1 = strongly disagree, 5 = strongly agree).

All four means sit only modestly above the scale midpoint of 3, and standard deviations above 1.0 show that opinions were divided. Financial incentives, the lever most directly tied to the cost barriers identified in the literature, scored lowest. Perceptions of sustainable agriculture itself were similar in level: resilience to climate shocks ($M = 3.44$, $SD = 1.122$), higher crop yields ($M = 3.42$, $SD = 1.013$) and efficient water use ($M = 3.31$, $SD = 1.090$).

4.3 Relationship between policies and sustainable agriculture

Government policies were strongly and positively correlated with sustainable agriculture ($r = 0.740$, $p < 0.01$).

Table 3: Regression of Sustainable Agriculture on the Predictors

Predictor	B	SE	Beta	t	Sig.
Constant	0.383	0.187		2.042	0.044
Government policies	0.177	0.083	0.178	2.120	0.036
Extension services	0.223	0.074	0.239	3.011	0.003
Technology awareness	0.516	0.085	0.516	6.043	0.000

Dependent variable = sustainable agriculture.

Holding the other predictors constant, government policies had a positive and statistically significant effect on sustainable agriculture ($\beta = 0.178$, $p = 0.036$). It was, however, the smallest of the three standardized effects, and its p-value was the closest to the 0.05 threshold.

4.5 Discussion

The central finding is that policy is positively and significantly associated with sustainable agriculture at Nasho. This supports the view that incentives, support programs and regulatory frameworks create conditions in which farmers can invest in and use solar irrigation effectively. It agrees with Ngango and Hong (2021), whose Rwandan households were more likely to adopt irrigation when they knew of subsidy programs and had access to credit and extension. It also matches Sanogo et al. (2025), where subsidies and institutional support raised adoption of solar pumps while high equipment costs persisted, and Agaton and Guno (2024), who found that incentives work best alongside farmer education and technical help.

Two features of the results qualify a simple "policy works" reading. First, the independent contribution of policy is modest: the strong correlation ($r = 0.740$) falls to a standardized coefficient of 0.178 once extension and awareness are controlled. Because policy overlaps heavily with both, a plausible interpretation is that part of its influence travels through those channels, for example when programs reach farmers through training and awareness activities. This interpretation fits the data but was not tested directly, for instance through mediation analysis.

Second, perceptions of policy are only moderately favorable, and financial incentives scored lowest. This

Policies were also highly correlated with technology awareness ($r = 0.757$) and extension services ($r = 0.713$), while extension services and technology awareness correlated with sustainable agriculture at $r = 0.739$ and $r = 0.824$ respectively.

4.4 Effect of government policies on the regression model

The joint model was significant, $F(3, 102) = 93.714$, $p < 0.001$, with $R = 0.857$, $R\text{-squared} = 0.734$ and adjusted $R\text{-squared} = 0.726$. Together, the three predictors explained 73.4% of the variance in sustainable agriculture (Table 3).

echoes the problem that motivated the study: national frameworks are supportive in design, but local implementation is uneven. Taken together, the findings indicate that policy supplies the institutional and financial foundation for sustainable agriculture, but that its effect depends on whether it is accompanied by technical support and farmer knowledge.

5. Conclusions and Recommendations

5.1 Conclusions

Government policies that promote solar-powered irrigation, through support, incentives, programs and promotion, had a positive and statistically significant influence on sustainable agriculture at Nasho. The influence was real but smaller than that of extension services and technology awareness, and respondents' ratings suggest that local delivery of policy can be strengthened. Policy is best treated as an enabling condition rather than a stand-alone solution.

5.2 Recommendations

The following recommendations are made based on the findings of the study:

1. The Ministry of Agriculture and Animal Resources, the Rwanda Agriculture and Animal Resources Development Board and local authorities should expand subsidies for solar irrigation equipment and create low-interest credit through institutions such as the Development Bank of Rwanda and savings and credit cooperatives.

2. District authorities and project managers should set up demonstration farms within schemes like Nasho and run regular monitoring and technical support to keep systems in use and well maintained.
3. Policy measures should be delivered together with extension visits and public awareness campaigns through radio, cooperatives, community meetings and digital platforms.

5.3 Limitations and further research

The cross-sectional, self-reported design supports conclusions about association, not causation, and the study covers one scheme with a small stakeholder population, so generalization should be cautious. Future studies should replicate the analysis in other Rwandan irrigation schemes, test whether extension and awareness mediate the effect of policy, and use longitudinal designs to track long-term effects

References

- Agaton, C. B., & Guno, C. S. (2024). *Promoting sustainable agriculture using solar irrigation: Case study of small-scale farmers in the Philippines*.
- Ahmad, N., Alias, F. A., Hamat, M., & Mohamed, S. A. (2024). *Reliability analysis: Application of Cronbach's alpha in research instruments*.
- Arslan, A., Floress, K., Lamanna, C., Lipper, L., & Rosenstock, T. S. (2022). A meta-analysis of the adoption of agricultural technology in Sub-Saharan Africa. *PLOS Sustainability and Transformation*, 1(7). <https://doi.org/10.1371/journal.pstr.0000018>
- Durga, N., Schmitter, P., Ringler, C., Mishra, S., Magombeyi, M. S., Ofosu, A., Pavelic, P., Hagos, F., Melaku, D., Verma, S., Minh, T., & Matambo, C. (2024). Barriers to the uptake of solar-powered irrigation by smallholder farmers in sub-Saharan Africa: A review. *Energy Strategy Reviews*, 51. <https://doi.org/10.1016/j.esr.2024.101294>
- Huang, W., & Wang, X. (2024). *The impact of technological innovations on agricultural productivity and environmental sustainability in China*. <https://doi.org/10.3390/su16198480>
- Ikundabayo, S., Bazimenyera, J. d. D., Bagaragaza, R., & Ngarukiyimana, J. B. (2026). Sustainable water management for irrigated agriculture in Rwanda: Systematic narrative review. *Brazilian Journal of Science*, 5(3), 58-70. <https://doi.org/10.14295/bjs.v5i3.823>
- Ministry of Agriculture and Animal Resources. (2018). *Strategic plan for agricultural transformation (PSTA 4) 2018-2024*.
- Ministry of Agriculture and Animal Resources. (2020, March 11). *Nasho solar-powered irrigation project to boost productivity and improve lives*. <https://www.gov.rw/blog-detail/nasho-solar-powered-irrigation-project-to-boost-productivity-and-improve-lives>
- Mukeshimana, G., Mupenzi, C., & Ndayambaje, J. (2022). Analysis of irrigation development to crop production in the Kirehe District: Case of Nasho irrigation schemes. *East African Journal of Science and Technology*, 12(1), 19-29.
- National Institute of Statistics of Rwanda. (2023, February 6). *Solar-powered irrigation: Changing lives of rural women farmers in Ngoma District*. <https://rwanda.un.org/en/218289-solar-powered-irrigation-changing-lives-rural-women-farmers-ngoma-district>
- Ngango, J., & Hong, S. S. (2021). Adoption of small-scale irrigation technologies and its impact on land productivity: Evidence from Rwanda. *Journal of Integrative Agriculture*. [https://doi.org/10.1016/S2095-3119\(20\)63417-7](https://doi.org/10.1016/S2095-3119(20)63417-7)
- Piñeiro, V., Arias, J., Dürr, J., Elverdin, P., Ibáñez, A. M., Kinengyere, A., Opazo, C. M., Owoo, N., Page, J. R., Prager, S. D., & Torero, M. (2020). A scoping review on incentives for adoption of sustainable agricultural practices and their outcomes. *Nature Sustainability*, 3.
- Sanogo, M., Yonaba, R., Keita, A., Lawane, A., Barbier, B., Aminatou, A. M. G., Bazié, I., & Ouarmé, S. (2025). *Adoption of solar-powered pumps in agriculture: Insights from smallholders in Burkina Faso*. <https://doi.org/10.1007/s44279-025-00205-8>
- Zemadim, B., Sanogo, K., Traore, S. S., Thai, M., & Kizito, F. (2023). Solar-based irrigation systems as a game changer to improve agricultural practices in sub-Saharan Africa: A case study from Mali. *Frontiers in Sustainable Food Systems*. <https://doi.org/10.3389/fsufs.2023.1085335>