

International Journal of Agriculture Extension and Social Development

Volume 7; Issue 3; March 2024; Page No. 64-67

Received: 13-12-2023
Accepted: 16-01-2024

Indexed Journal
Peer Reviewed Journal

Designing performance assessment systems for climate-adaptive agricultural extension initiatives in drought-prone areas

¹ Dr. Sokha Chea, ² Dr. Rithy Ouk, ³ Dr. Sreymom Khim, ⁴ Dr. Vibol Phan and ⁵ Channary Sok

¹⁻⁴ Department of Agricultural Extension, Mekong Valley University of Agriculture, Cambodia

⁵ Professor, Department of Agricultural Extension, Mekong Valley University of Agriculture, Cambodia

DOI: <https://www.doi.org/10.33545/26180723.2024.v7.i3a.3293>

Corresponding Author: Dr. Sokha Chea

Abstract

Most climate-adaptive agriculture extension programs in drought-prone regions operate without functional performance assessment systems. This research developed and tested an M&E framework for CSA extension programs across four drought-prone provinces in Cambodia (April 2021 to June 2022). A mixed-methods approach surveyed 48 extension program units and conducted interviews with 36 program managers. The proposed framework incorporated four components: process monitoring, output assessment, outcome evaluation, and impact analysis linked through a feedback loop. Programs with higher M&E implementation scores showed significantly stronger outcomes ($r = 0.73$, $p < 0.001$). Process monitoring and outcome evaluation emerged as the strongest predictors of program effectiveness (Beta = 0.34 and 0.28 respectively). The framework offers a practical, adaptable tool for strengthening accountability and adaptive management in CSA extension delivery.

Keywords: Monitoring and evaluation, climate-adaptive agriculture, extension programs, drought-prone regions, M&E framework, program effectiveness, adaptive management, agricultural extension, impact assessment

1. Introduction

Climate-smart agriculture extension programs are expanding rapidly across drought-prone regions, but the systems meant to track their performance have not kept pace ^[1]. Without functional performance assessment frameworks, extension agencies struggle to determine which CSA practices are actually reaching farmers, whether adoption rates match program targets, and how climate variability affects intervention outcomes ^[2]. The result is a growing disconnect between program investment and demonstrable results.

Existing M&E approaches for agricultural extension were largely designed for conventional programs and do not adequately capture the multi-dimensional nature of CSA outcomes — which span productivity, adaptation, and mitigation goals simultaneously ^[3]. Semi-arid regions present additional challenges: rainfall variability makes year-to-year comparisons difficult, farmer populations are often dispersed, and program impacts may take several seasons to materialize ^[4, 5].

This research addressed these gaps by developing and field-testing an integrated M&E framework tailored to CSA extension programs in drought-prone settings. Cambodia's drought-prone provinces provided the research context, where multiple CSA extension programs were operating with varying levels of monitoring capacity ^[6, 7].

provinces in Cambodia: Battambang, Banteay Meanchey, Siem Reap, and Kampong Thom. These provinces fall within the dry zone receiving 1,000-1,400 mm annual rainfall concentrated in the May-November wet season. Mean temperatures ranged from 24.3°C to 33.8°C during the research period (April 2021 to June 2022). The 2021 wet season brought below-average rainfall in Battambang and Banteay Meanchey (deficit of 18-22%), creating conditions that tested M&E responsiveness.

Material

All 48 CSA extension program units operating in the four provinces were included through a census approach. Additionally, 36 program managers were purposively selected for in-depth interviews. A structured M&E assessment tool was developed containing 42 indicators across four framework components: process monitoring (12 indicators), output assessment (10 indicators), outcome evaluation (11 indicators), and impact analysis (9 indicators). Each indicator was scored on a 4-point scale. The tool was validated by a panel of eight CSA and M&E experts and pre-tested with six program units in Pursat province. Ethics approval was granted by Mekong Valley University of Agriculture, Cambodia (Ref: MVUA/KH/2021-031, March 2021).

Research Design

A cross-sectional descriptive design was used. Data collection occurred in two rounds: the first (April-August

Material and Methods

Research Area

The research was conducted across four drought-prone

2021) assessed existing M&E capacity, and the second (January-June 2022) evaluated pilot implementation of the proposed framework in 18 volunteer program units. Program outcome data were extracted from official extension records for the 2021 agricultural season.

Methods

Quantitative data were analyzed in SPSS 26.0. Pearson correlation examined the relationship between M&E

implementation scores and program outcome indices. Multiple regression identified which framework components best predicted program effectiveness. Qualitative data from interviews were analyzed thematically. A composite program outcome index was constructed from adoption rates, yield changes, and farmer satisfaction scores^[8].

Results

Table 1: Baseline M&E capacity scores across 48 CSA extension program units

M&E Component	Mean Score (%)	SD	Min	Max	Programs Scoring >60%	Gap Index
Process Monitoring	54.7	18.3	21.4	89.6	19 (39.6%)	0.45
Output Assessment	61.2	15.8	28.7	91.3	26 (54.2%)	0.39
Outcome Evaluation	42.8	21.6	11.2	84.7	13 (27.1%)	0.57
Impact Analysis	31.4	19.7	8.3	72.1	8 (16.7%)	0.69
Overall M&E Score	47.5	16.4	18.9	82.4	15 (31.3%)	0.53

Table 1 shows baseline M&E capacity across the 48 program units. Output assessment had the highest mean score (61.2%), while impact analysis scored lowest (31.4%). Only 16.7% of programs scored above 60% on impact

analysis. The gap index measuring the distance between current and target performance was largest for impact analysis (0.69) and smallest for output assessment (0.39).

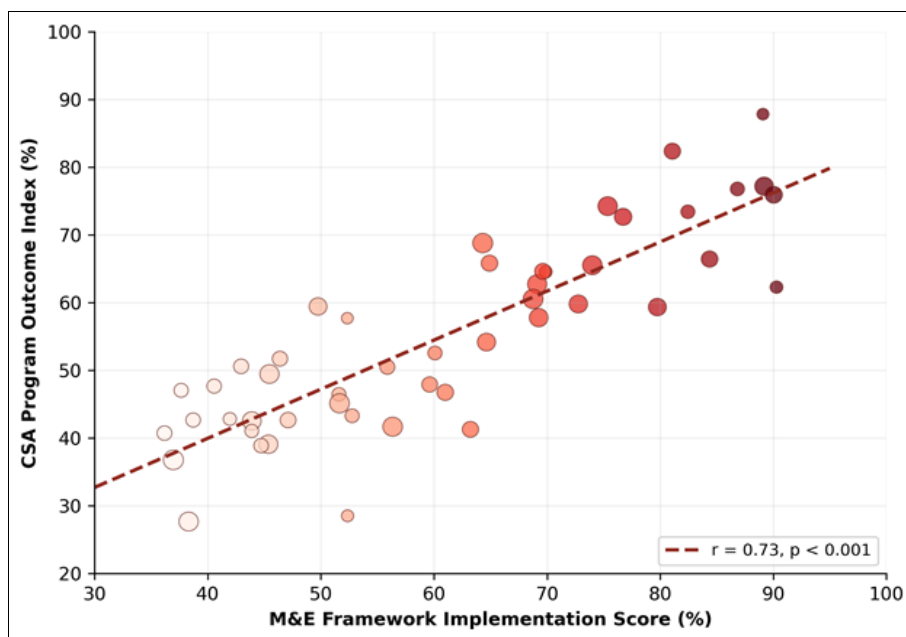


Fig 1: Scatter plot of M&E implementation scores versus CSA program outcome indices

Figure 1 displays the positive correlation between M&E framework implementation scores and CSA program outcome indices across the 48 units ($r = 0.73$, $p < 0.001$). Programs with M&E scores above 70% consistently

achieved outcome indices above 60%, while those below 40% showed highly variable and generally weaker outcomes.

Table 2: Regression of M&E framework components predicting program effectiveness

Framework Component	B	SE	Beta	t	p-value
Process Monitoring	0.41	0.11	0.34	3.73	< 0.001
Output Assessment	0.26	0.13	0.19	2.00	0.052
Outcome Evaluation	0.38	0.12	0.28	3.17	0.003
Impact Analysis	0.21	0.14	0.14	1.50	0.141

Regression analysis (Table 2) revealed that the four M&E components collectively explained 58.7% of variance in program outcomes ($R^2 = 0.587$, $F(4,43) = 15.29$, $p < 0.001$). Process monitoring was the strongest predictor (Beta =

0.34), followed by outcome evaluation (Beta = 0.28). Output assessment approached significance ($p = 0.052$), while impact analysis did not reach significance independently.

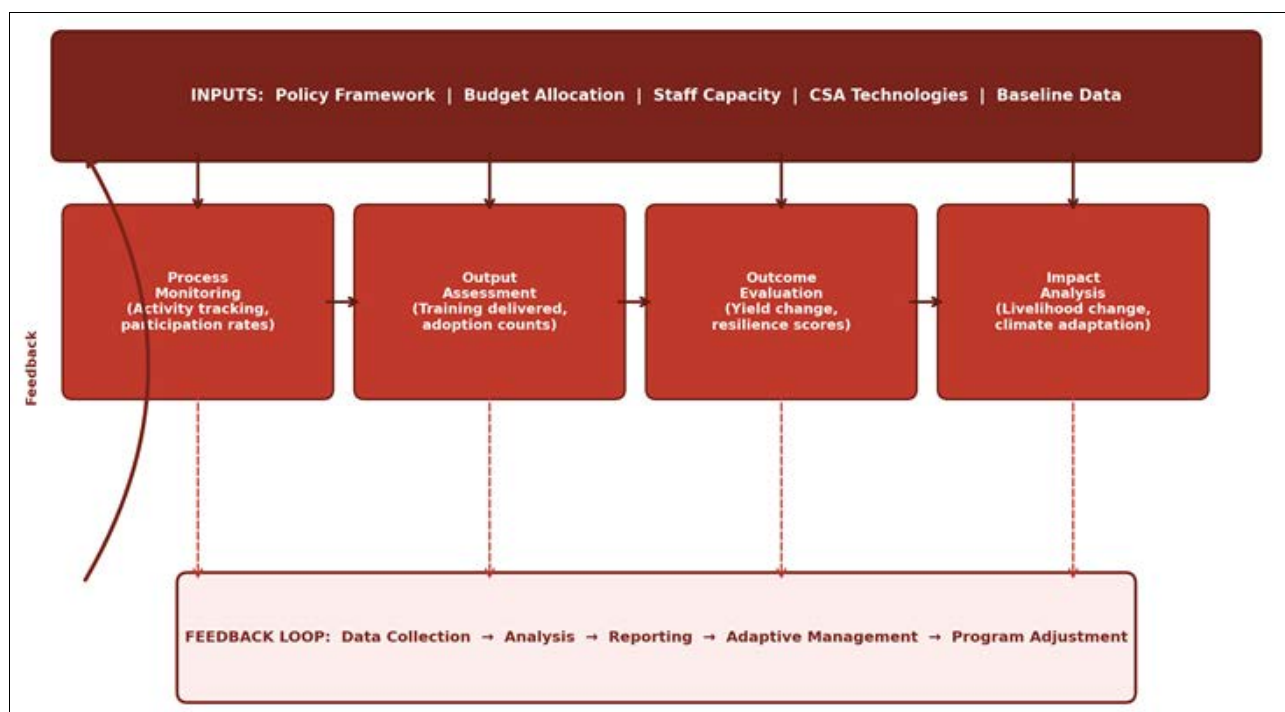


Fig 2: Schematic of the proposed M&E framework for CSA extension programs

Figure 2 presents the proposed M&E framework schematic, illustrating how the four components connect sequentially from inputs through impact analysis, with a continuous feedback loop enabling adaptive program management based on collected evidence.

Discussion

The finding that process monitoring was the strongest predictor of program effectiveness aligns with Thornton *et al.* ^[9] who argued that consistent activity tracking enables early course corrections in CSA programs. The weak independent contribution of impact analysis likely reflects its longer time horizon most CSA impacts in drought-prone areas take 2-3 seasons to materialize, exceeding the typical annual reporting cycle ^[10].

The strong correlation ($r = 0.73$) between M&E implementation and program outcomes is consistent with evidence from Lamanna *et al.* ^[11] that structured accountability mechanisms improve extension performance. The gap analysis revealed that most programs had basic output tracking but lacked the capacity for outcome-level assessment a pattern also documented by Rosenstock *et al.* ^[12] in East African CSA programs. The feedback loop component was identified by program managers as the most valuable but least implemented element ^[13].

Conclusion

This research presents an integrated M&E framework for CSA extension programs that addresses the specific challenges of drought-prone settings. Process monitoring and outcome evaluation were the strongest drivers of program effectiveness, while impact analysis capacity remained the weakest area across programs. The framework's feedback loop mechanism provides a practical pathway for adaptive management. Extension agencies should prioritize building process monitoring systems as the foundation and progressively add outcome and impact

components as institutional capacity grows ^[14].

References

1. Lipper L, Thornton P, Campbell BM, Baedeker T, Braimoh A, Bwalya M, *et al.* Climate-smart agriculture for food security. *Nature Climate Change*. 2014;4(12):1068-1072.
2. McCarthy N, Lipper L, Branca G. Climate-smart agriculture: smallholder adoption and implications for climate change adaptation and mitigation. *Mitigation of Climate Change in Agriculture Working Paper No. 3*. Rome: Food and Agriculture Organization of the United Nations; 2011. p. 1-37.
3. Branca G, McCarthy N, Lipper L, Jolejole MC. Climate-smart agriculture: a synthesis of empirical evidence. *Mitigation of Climate Change in Agriculture Working Paper No. 3*. Rome: Food and Agriculture Organization of the United Nations; 2011. p. 1-42.
4. Shiferaw B, Tesfaye K, Kassie M, Abate T, Prasanna BM, Menkir A. Managing vulnerability to drought and enhancing livelihood resilience in sub-Saharan Africa. *Weather and Climate Extremes*. 2014;3:67-79.
5. Khatri-Chhetri A, Aggarwal PK, Joshi PK, Vyas S. Farmers' prioritization of climate-adaptive agriculture technologies. *Agricultural Systems*. 2017;151:184-191.
6. Mekong River Commission. Climate change adaptation in the lower Mekong basin countries. *MRC Technical Paper No. 40*. Vientiane: Mekong River Commission; 2014. p. 1-68.
7. Touch V, Martin RJ, Scott JF, Cowie A, Liu DL. Climate change impacts on rainfed cropping production systems in the tropics. *Climatic Change*. 2016;136(3):605-621.
8. Kristjanson P, Neufeldt H, Gassner A, Mango J, Kyazze FB, Desta S, *et al.* Are food insecure smallholder households making changes in their farming practices? *Food Security*. 2012;4(3):381-397.

9. Thornton PK, Whitbread A, Baedeker T, Cairns JE, Vervoort J, Lamanna C, *et al.* A framework for priority-setting in climate smart agriculture research. *Agricultural Systems*. 2018;167:161-175.
10. Rosenstock TS, Lamanna C, Chesterman S, Bell P, Arslan A, Richards M, *et al.* The scientific basis of climate-smart agriculture: a systematic review protocol. CCAFS Working Paper No. 138. Copenhagen: CGIAR Research Program on Climate Change, Agriculture and Food Security; 2016. p. 1-28.
11. Lamanna C, Hasan B, Ghosh A, Vervoort J, Donatti CI, Nowak A, *et al.* Strengths and limitations of computer assisted telephone interviewing for monitoring in developing countries. *PLoS ONE*. 2019;14(4):e0214749.
12. Rosenstock TS, Nowak A, Girvetz E, editors. *The climate-smart agriculture papers: investigating the business of a productive, resilient and low emission future*. Cham: Springer; 2019. p. 1-313.
13. Westermann O, Thornton P, Forch W. Reaching more farmers—innovative approaches to scaling up climate-smart agriculture. CCAFS Working Paper No. 135. Copenhagen: CGIAR Research Program on Climate Change, Agriculture and Food Security; 2015. p. 1-38.
14. Neufeldt H, Jahn M, Campbell BM, Beddington JR, DeClerck F, De Pinto A, *et al.* Beyond climate-smart agriculture: toward safe operating spaces for global food systems. *Agriculture and Food Security*. 2013;2(1):12.