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Sustainability of Community-Based Armyworm Forecasting in Moshi District, Kilimanjaro Region, Tanzania

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Abstract: ***This research highlights the key predictors of a sustainable community project, hence it contributes to the knowledge base of sustainable education. A correlational design was adopted to describe the relationship between financial resources, stakeholder involvement, capacity building, exit strategy and sustainability of Community-based Armyworm forecasting, (CBAF). The target population comprised of 290 farmers in Moshi district, Kilimanjaro region. Stratified random sampling was used to select a sample of 169 from the population. A researcher's self-developed questionnaire was used as a data collection tool. Data analysis involving Pearson correlation and linear multiple regression conducted by use of Statistical Package for Social Sciences (SPSS). A majority of the farmers felt that the CBAF project's sustainability was low (n= 34, 41.5%), although a total of 58.5% of farmers felt sustainability as somehow high, high and very high. This may have arisen from inadequate finances, poor ownership of the project arising from poor stakeholder commitment and loosely packaged exist strategy. The study established significant positive correlations between stakeholder involvement (r=.58), capacity building (r=.47), financial resources (r=.51), exit strategy (r=.55) and sustainability of CBAF. It was also found that a combination of stakeholder involvement, capacity building, financial resources, exist strategy accounted for 51.6% of the variability in the sustainability of CBAF, F (4, 81) = 20.56, p<.05. The resultant model showed that an improvement in stakeholder involvement, capacity building, financial resources and exist strategy by one unit would augment the sustainability of CBAF by .26, .20, .19, and .27 respectively. Therefore, stakeholder involvement and commitment, capacity building, financial resources, and exit strategy are key to the continuity of the community-based Armyworm forecasting project. To improve the sustainability of the project there is need for use of locally available materials to make pest traps, extension agents should expand the training programs to cover more farmers coupled with regular follow-ups, and also a clear policy framework that guides community projects exist by the funders should be put in place.***

Keywords: Capacity building, exit strategy, financial resources, project sustainability, stakeholder involvement

1. Introduction

Ensuring community-based project sustainability is essential for the development of the targeted communities. Project sustainability comprises of a set of characteristics including adaptability, auditability, maintainability, implementability, scalability, extensibility and manageability [1]. The sustainability of any community-based project relies on community-based approaches that taps on the community's capabilities and resources, commands community acceptance and involvement, requires social-cultural acceptance and management capabilities [2]. Lack of any of the aforementioned elements compromises the continuity of most community projects. Research has demonstrated that about forty percent of the donor-funded projects assumes a natural death after a few years of termination of funding [3]. A lot of resources have been committed and continue to be dispensed to run the community-based projects to sustain development especially in developing countries. The continued death of some of these projects has been a cause of concern not only to the funders but also researchers. However, there is not adequate information to unravel the mystery.

Tanzania has been experiencing armyworm attack almost every year. Between 2001 and 2012 a total of 445,652 Ha have been infested. The African armyworm, *Spodoptera exempta* is a caterpillar of a night fly moth, attacking cereal crops in Africa [5]. The larvae is a serious pest attacking *graminae* crops like maize, paddy, sorghum, wheat, and pasture grass. The damage of the pest to the field may results in a 100% loss [6] if not controlled. Community-Based Armyworm forecasting for improved cereal productivity and profitability (CBAF) project implemented from July 2007 to June 2010 in Malawi, Tanzania, and Zimbabwe. The project supported through European Development Fund empowered farmers in Tanzania (145 villages), Malawi (85 villages) and Zimbabwe (54 villages) through capacity buildings and technological equipment that has helped them reduce crop losses and save costs. The forecasting system entailed setting traps on the crop fields and subsequent analysis of data collected from installed traps to predict the armyworm outbreaks. The armyworm forecasting system work by understanding armyworm migrations using pheromone traps located in districts, villages and selected centers [7]. The trap is placed with pheromone, a scent that attracts matured male armyworm moth. Until 2015, 29 districts in Tanzania have benefited with this initiative with a total of more than 300 villages. According to a survey report of Plant health services-Northern zone in 12 districts, it was found that 80 out of 124 villages visited were not operating the initiative [21].

By 2010 in Tanzania, CBAF had trained about 290 farmer forecasters who were then expected to train other farmers through a training of trainers' framework [4]. The project was intended to empower the local community to use an early cautionary tactic that involved prediction of armyworm outbreaks/occurrences using special traps operated at village level, as a tool to control armyworm attack to their crops

hence ensuring food security and raise income to rural communities. CBAF has proved beneficial in the management of the pest [4] and thus can be sustained when a project buy-in created among the stakeholders.

Prior to the termination of the funding, project continuity mechanisms were put in place. The mechanisms included the formulation of an armyworm policy and implementation of a national plan of community-based armyworm forecasting in the three countries that would ensure farmers in outbreak-prone areas stakeholders to reap the benefits of the project [4]. Numerous benefits have been cited by the farmers accruing from the project with the major one being an early warning on possible armyworm outbreaks that sparks the preparedness of farmers to deal with the pest. However, there is no adequate data indicating the key ingredients of continuity of this and similar agricultural related projects particularly in Africa, avoid that this research was set out to contribute to.

2. Conceptual Framework

This study had hypothesized that financial resources, stakeholder involvement, capacity building and exist strategy were closely associated with the sustainability of CBAF (Figure 1). Sustainable mechanisms to be adopted by farmers when the project comes to an end include the use of local governance structures of local leaders at village level and farmers in project implementation a sustained source of resources for each input previously provided by the project are required for sustainability. Finance resources could come from activities that were run profitably using business mode, funds secured through government operating budgets, contribution by community members [8]. Financial sustainability is, therefore, a key factor for the sustainability of the project given that there some activities that require cash flow. Training community both technically and management skills are the key success in ensuring project sustainability. To achieve sustainability community should possess adequate management capabilities to ensure proper implementation [2]. Management capability is brought through training and active participation during the project cycle. Capacity building should aim at institutional capacity at a community level. In addressing the institutional sustainability, the critical steps in promoting sustainability include; promoting institutional ownership of project activities [9].

Locally initiated programs may be more sustainable. Involving all relevant community leaders and agencies facilitate sustaining programs [10]. Community participation is very important as it is a process of interactive dialogue, collective analysis, and joint action. Participation is progressively handing over power and control to local partners so that they can set their own development agenda [11]. An exit strategy for a program is a specific plan describing how the program will withdraw from a region or population while ensuring that the achievement of development goals is not jeopardized. It is explicitly linked to sustainability in that it also considers means of ensuring further progress towards these goals after the end of an agency's technical and financial support. Exit refers to withdrawal from the operational area of externally provided resources, whether material goods, human resources or technical assistance [9]. The goal of an exit strategy is to ensure the sustainability of program impacts and activities. The exit strategy may be phasing out, phasing over or phasing down depending on the type of the project and other factors [9].

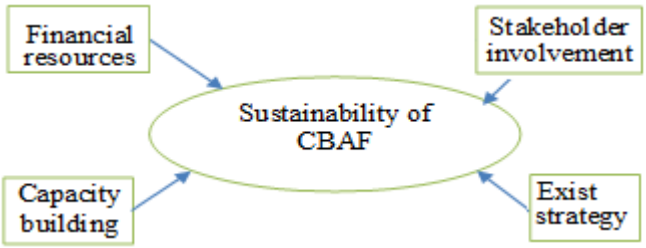

Figure 1: Link between sustainability of Community-based projects and its main predictors

3. Purpose and Objectives

Overall, the research was intended to create an understanding of the key ingredients of sustainable community-based armyworm forecasting techniques. Specifically, the study sought to describe the characteristics of the community-based armyworm forecasting project (CBAF), and ascertain if financial resources, stakeholder involvement, capacity building and exist strategy explained a significant variation in the sustainability of CBAF.

4. Methods

The study involved a population of 290 farmers in Moshi district, Kilimanjaro region. Stratified random sampling was used to select a sample of 169 [12] from the forecasting population. A correlational research design was utilized to address the study objectives. A correlational research design as research that involves collecting data in order to determine the degree to which an association exists between two or more variables [13]. A researcher's self-developed questionnaire was used as a data collection tool. Peers and experts in project management were invited to check face and content validity of the instrument. Pilot study data collected from 15 farmers were used to analyze the internal consistency of the independent variable through Cronbach alpha computation. The pilot study was also used to revise the instrument to align the questions to the objectives. The Cronbach's alpha value was .78 which was above the minimum acceptable alpha of .7 [14]. The study achieved a response rate of 49%, this was considered reasonable as a response rate of more than 30% of the total sample size provides enough data for further analysis of the population [19].

Pearson product moment correlation was run to determine the relationship between financial resources, stakeholder involvement, capacity building, exit strategy and sustainability of CBAF. Linear multiple regression was used to ascertain if financial resources, stakeholder involvement, capacity building and exist strategy explained a significant variation in the sustainability of CBAF. The goodness of fit of the sample data to the population was evaluated through the R squared, F- test, and Root Mean Square Error (RMSE) test as well as Cook's distance. The assumption of no

multicollinearity between predictor variables was addressed through Pearson correlation and collinearity statistics (tolerance and variance inflation factors (VIF). Bivariate correlations between the independent variables of greater than .80 are problems [15]. The tolerance factor should be more than 0.2 [16] and VIF should be less than 10 [17] Durbin-Watson test statistic was used to test the correlation between errors. Values of Durbin-Watson less than 1 and greater than 3 are a cause of concern [18].

5. Results and Discussion

Characteristics of CBAF

The first objective sought to describe the characteristics of CBAF specifically, the level of stakeholder involvement, financial resources, capacity building, and exit strategy. These characteristics were assessed by use of a four-point Likert type scale items. The scale ranged from 1 which meant strongly agree to 4; which meant strongly disagree.

Stakeholder Involvement in CBAF

Table 1 presents the frequencies and percentages of respondents' level of agreement regarding the level of involvement of stakeholders in the CBAF project. The results indicated that very few farmers were involved during the formulation (*n* = 10, 12.2%) and planning of the project (*n*=12, 14.6%). However, they (*n* = 82, 100%) all participated in the implementation of CBAF project. About ninety-nine percent (*n*= 81, 98.8%) claimed to have worked closely with the District Agriculture Officers and the other community members to ensure that the projects were a success. The respondents stated that the project was characterized by routine project monitoring follow-ups (*n*= 72, 87.8%), and stakeholder involvement in monitoring and evaluation (*n*= 57, 69.5%) especially at the initial implementation stages. The day to day management of the project was undertaken by the agricultural officers, only a handful of community members (*n*= 14, 17.1%) and other stakeholders (*n*= 16, 19.5%) were included in training but there was no management committee formed. This clearly shows that the project stakeholders were heavily involved in the implementation, monitoring, and evaluation and minimally engaged during its design, planning, and management. Adequate involvement of stakeholders and particularly the community expected to benefit from the project is needed to create a sense of ownership [19] and also for sustainability. Engaging the community at all stages of the project attracts the spirit of cooperation, social trust and support [20] all of which boosts the adoption of the technologies being disseminated. However, the study found out that the community and to a larger extent stakeholders were not fully involved at some stages of the project and this resulted in low sustainability levels (Table 1).

Table 1: Descriptive Statistics on Stakeholders Involvement in CBAF Project (N= 82)

Statement	Strongly agree	Agree	Disagree	Strongly disagree	*M*
The community participated in project formulation	10(12.2)	0(0.0)	39(47.6)	33(40.2)	3.16
Community involved in project planning	10(12.2)	2(2.4)	52(63.4)	18(22.0)	2.95
Community involved in project implementation	36(43.9)	46(56.1)	0(0.00)	0(0.0)	1.56
District and village community worked very closely during the project	38(46.3)	43(52.4)	1(1.2)	0(0.0)	1.55
Village community worked very closely with the district after the project finished	12(14.6)	41(50.0)	29(35.4)	0(0.0)	2.21
There was routine project monitoring and follow up during implementation	14(17.1)	58(70.7)	9(11.0)	1(1.2)	1.96
Stakeholders are involved in project monitoring and evaluation	11(13.4)	46(56.1)	24(29.3)	1(1.2)	2.18
Community members are part of the project committee	11(13.4)	3(3.7)	62(75.6)	6(7.3)	2.77
Project management committee includes other stakeholders	11(13.4)	5(6.1)	63(76.8)	3(3.7)	2.71

Capacity Building of CBAF Project Beneficiaries

As reported in Table 2, the study found that the communities where the project was undertaken were fully aware of the problems that arose from the armyworm infestation (*n*= 73, 89%), and the community armyworm forecasting project. The respondents confirmed that they had been trained on the use of CBAF equipment (*n*= 72, 87.8%), and how to predict and manage the armyworm menace (*n*= 73, 89%). However, not all of the experienced community forecasters provided training to neighboring villages as it had been planned (*n*= 46, 56.1%). The respondents acknowledge that the community forecasters were given information leaflets that would facilitate them to train others (*n*= 66, 80.5%). A majority of the farmers felt that not adequate follow-ups were undertaken to ensure traps and rain-gauges were well sited, data recording and weekly forecasts carried out accurately (*n*= 50, 61%) after project duration. The findings suggest that even though the farmers were trained to site and fix traps and rain-gauges, collect and analyze data to aid the forecasts, the training programs were not regular and adequate. This may have compromised the sufficiency of knowledge and skills by the forecasters thus jeopardizing the sustainability of the projects. Since the project had adopted a training of trainers approach, it would have been proper to train the trainers adequately enough to motive and give them the confidence to disseminate the skills to the rest of the community members. This actually explains why some of the trained farmer forecasters did not participate in training the rest of the community.

Table 2: Descriptive Statistics on CBAF Forecasters' Capacity Building (N=82)

Statement	Strongly agree	Agree	Disagree	Strongly disagree	*M*
The community are aware of armyworm problem	51 (62.2)	22 (26.8)	6 (7.3)	3 (3.7)	1.52
The community were trained on CBAF	23 (28.0)	49 (59.8)	7 (8.5)	3 (3.7)	1.88
It covered the use of the equipment and how, farmers can predict	42 (51.2)	31 (37.8)	6 (7.3)	3 (3.7)	1.63

armyworm outbreaks and tentatively control the pest					
Experienced community forecasters provided training to neighboring villages	1 (1.2)	45 (54.9)	33 (40.2)	3 (3.7)	2.46
Community forecasters were provided with information leaflets on the use of project equipment	10 (12.2)	56 (68.3)	13 (15.6)	3 (3.7)	2.11
The training was adequate and followed up to ensure traps and rain-gauges were well sited, data recording and weekly forecasts carried out accurately	0 (0.0)	32 (39.0)	5 (6.1)	45 (54.9)	3.43

Financial Resources for CBAF Project

Financial resources are a basic need for projects during initiation and also to cover the daily running costs. Table 3 describes the financial characteristics of CBAF. The project was designed with very little resource contribution from the benefiting communities (*n*= 2, 2.4%). The respondents noted that after the termination of funding there were not adequate resources to cover the project running costs (*n*= 79, 96.1%). Although there was no enough fund to run the project (*n*= 76, 92.7%), most of the community members were willing to contribute (*n*= 55, 67%). It had been anticipated that after withdrawal of European Union funding, the community will contribute resources to sustain the project, however, on the contrary very little resources had been contributed (*n*= 73, 89%) and this led to poor performance. Most of the farmers stated that the project was majorly donor-funded and there was no financial mechanism put in place after the project ended. The community members indicated that they had not experienced funding challenges during implementation because the project fund was available and disbursed timely by the donor.

Table 3: Descriptive Statistics on Financial Resources for CBAF (N=82)

Statement	Strongly agree	Agree	Disagree	Strongly disagree	*M*
The project was designed with some community some support from the self-financing mechanism	0 (0.0)	2 (2.4)	28 (34.1)	52 (63.4)	3.59
Maintenance cost was available after the project finished	1 (1.2)	2 (2.4)	54 (65.9)	25 (30.5)	3.24
We have adequate funds to run the project	2 (2.4)	4 (4.9)	68 (82.9)	8 (9.8)	3.00
As a member of community am ready to contribute	2 (2.4)	53 (64.6)	27 (32.9)	0 (0.0)	2.30
Community members contribute monthly to run the project	1 (1.2)	2 (2.4)	47 (57.3)	32 (39.0)	3.33
Occasionally we experience funds shortage in our project	2 (2.4)	25 (30.5)	53 (64.6)	2 (2.4)	3.01
The project not performing well due to fund shortage	23 (28.0)	50 (61.0)	9 (11.0)	0 (0.0)	1.83

Exit Strategy for the CBAF Project

An exit strategy that is planned and implemented together with the partner from the beginning of the project increases chances of the project to achieve better and sustainable results, clarifies project planning, reinforces the commitment and increases project ownership. As reported in Table 4, there was not a well thought of an exit plan that was being followed to create project ownership (*n* = 63, 76.9%). The roles of the stakeholders were clearly clarified to ensure continuity of the project after the exit of the donors (*n* = 51, 62.2%), and the community had a contract outlining who will take up what role after the termination of donor funding (*n* = 39, 47.5%). At the closure of donor activities, a meeting was held to release the project to the community and also official handing over procedures were followed to the later. The study suggests that the exit strategy put in place was not adequate and adapted from the beginning of the project to ensure a gradual and smooth release of the project to the communities. This may have comprised its level of sustainability.

Table 4: Descriptive Statistics on Exit Strategy of a CBAF Project (N=82)

Statement	Strongly agree	Agree	Disagree	Strongly disagree	M
There was well thought of exit plan that was being followed to create project ownership	2(2.4)	17(20.7)	44(53.7)	19(23.2)	2.79
Roles of stakeholders were clearly known	17(20.7)	34(41.5)	31(37.8)	0(0.0)	2.17
There was a project contract agreement for community	17(20.7)	22(26.8)	0(0.0)	43(52.4)	3.11
Closure meeting for the project was done	7(8.5)	31(37.8)	10(12.2)	34(41.5)	3.00
The community were involved in implementation as partners	38(46.3)	43(52.4)	1(1.2)	0(0.0)	1.55
There was a transitional procedure to hand over to the community	16(19.5)	2(2.4)	40(48.8)	24(29.3)	2.73
The project was clearly handed over to the community	17(20.7)	1(1.2)	39(47.6)	25(30.5)	2.87

Sustainability of CBAF Project

The results in Figure 2 indicate that the project a majority of the farmers (*n* =34, 41.5%) rated CBAF project sustainability as low, although total percentage for somehow high, high and very high is (*n*=48, 58.5%) which shows CBAF has sustainability potential. Low rating of sustainability may have been brought about by inadequate stakeholder involvement at all stages of the project; design, planning, implementation, monitoring and evaluation, poor exit plan, inadequate resources, and capacity building.

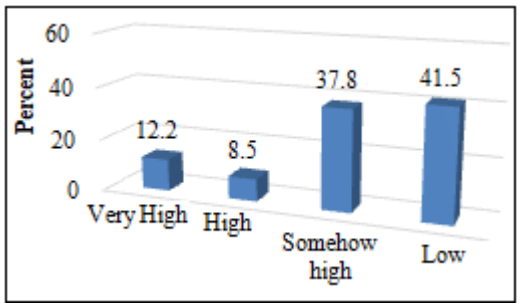

Figure 2: Sustainability of CBAF (N=82)

Objective two sought to determine if financial resources, stakeholder involvement, capacity building and exist strategy explained a significant variation in the sustainability of CBAF. Multiple regression was conducted to determine if a combination of financial resources, stakeholder involvement, capacity building and exist strategy would significantly predict the sustainability of CBAF. Prior to running the regression test, the assumptions were checked; kurtosis and skewness were used to test normality while Pearson correlation was run to test for the presence of multicollinearity among the independent variables. The residuals were found to be normally distributed. As reported in Table 5, the correlations ranged between r =.09 to r =.58, meaning that the assumption of multicollinearity was met. The correlation between sustainability of CBAF and predictors ranged from moderate; capacity building (r = .47) to substantial; stakeholder involvement (r = .58) as interpreted by Davis (1971).

Table 5: Intercorrelation for Sustainability of CBAF and Predictor Variables (N=82)

Variable[a]	1	2	3	4	5
1. Stakeholder involvement	-	09	23*	48**	.58**
2. Capacity building		-	56**	34**	.47**
3. Financial resources			-	25*	.51**
4. Exit strategy				-	.55**
5. Sustainability of CBAF					-

Note. [a]1= strongly disagree, 2= disagree, 3= agree, 4= strongly agree; ** p<.01 * p<.05

The results indicated that a combination of financial resources, stakeholder involvement, capacity building and exist strategy significantly predicted the sustainability of CBAF, F (4, 77) = 20.56, p <.05 with the four variables significantly contributing to the prediction. The adjusted R^2 value was .49 while the R^2 value was .52. This shows that 49% of the variance in the sustainability of CBAF was explained by the model. This according to Cohen 1988 was a large effect. As shown in Table 6, an increase in stakeholder involvement, capacity building, financial resources and exit strategy by one unit would improve the sustainability of CBAF by .26, .20, .19, and .27 respectively.
The resultant model was as follows

$$Sustainability\ of\ CBAF = 0.445 + 0.26(Stakeholder\ involvement) + 0.20(capacity\ building) + 0.187(financial\ resources) + 0.27(exit\ strategy)$$

Table 6: Regression of Stakeholders Involvement, Capacity Building, Financial Resources, Exit Strategy and Sustainability of CBAF (N=84)

Variable[a]	Unstandardized Coefficients		Standardized Coefficients	t	p
	β	SE	β		
(Constant)	.45	.22		2.02	.05
Stakeholders involvement	.26	.09	.28	2.73	.01
Capacity building	.20	.09	.19	2.10	.04
Financial resources	.19	.08	.21	2.23	.03
Exit strategy	.27	.09	.29	3.16	.02

F (4, 77) = 20.56, p <.05, Adjusted R^2 =.49, R^2 = .52, p<.05

Conclusion and Implications

The sustainability community-based armyworm forecasting system (CBAF) was found low as reported by the sustainability level mean score. The low levels of sustainability of the project resulted from inadequate stakeholder involvement at all stages of the project; design, planning, implementation, monitoring and evaluation, poor exit plan, inadequate resources, and capacity building. The stakeholders were heavily involved in the implementation, monitoring, and evaluation and minimally engaged during its design, planning, and management. Adequate involvement of stakeholders and particularly the community expected to benefit from the project is needed to sustain the project by creating a sense of ownership. The findings suggest the community forecasters were adequately trained to cite, fix traps and rain-gauges, collect and analyze data to aid the forecasts but were not motivated. The training programs were inadequate subjecting sufficiency of knowledge and skills planned to be imparted to forecasters, thus compromising the sustainability of the project. In addition, the continuity of training of trainers' framework was not well streamlined resulting in a discontinuation of the training. It was also palpable that project was majorly donor-funded and no financial sourcing mechanism put in place to ensure the continuation of project funding. Although the release of the project was procedurally executed the exit strategy put in place was not adequate and adapted from the beginning of the project to ensure a gradual and smooth release of the project to the communities. Therefore, with adequate financial resources, stakeholder involvement, capacity building, and exit strategy, armyworm forecasting would have been sustained.

To reverse the poor trend of CBAF, District Agricultural officers through district authorities needs to organize planning workshops involving key stakeholders to discuss sources of finance and other resources, clarify the roles of each stakeholder, and organize refresher training programs for the forecasters charged with the responsibility of training others. The Ministry of agriculture and district authority needs to set aside funds to ensure supply of required tools and to facilitate monitoring, evaluation and follows ups by the Agricultural officers to ensure that the project continue running smoothly. The communities benefitting from the project should be mobilized to contribute resources for the project so as create a sense of ownership. Had the community been involved right from the formulation of the project its sustainability would not have been compromised and the intended benefits would have been achieved. Many

of the donor-funded projects are conceptualized and formulated without the knowledge of the key beneficiary and this makes it difficult if not impossible for them to own it. This research covered four predictors which were found to account for 49% of the variability of sustainability of community projects. This, therefore, creates a need for further studies to unravel the elements that explain the remainder of the variability.

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