Volume: 15, Issue: 1
Page: 94-105
2022

International Journal of Science and Business

Journal homepage: ijsab.com/ijsb

Factors influencing participation in Integrated Catchment Management programmes in Lesotho: The case of Lekhobanyane catchment

Moselantja Molaoa & Brian Muroyiwa

Abstract

Integrated Catchment Management is increasingly becoming important in Lesotho where the majority of the population depends on the agricultural economy that is threatened by continuous multiple forms of land degradation that affect land use patterns. ICM requires ongoing participation to engage different stakeholders to address social aspects required to improve environmental approaches, social systems and policy initiatives to minimise effects of land degradation due to intensive unsustainable land management, climate change and extreme climatic hazards that result in excessive tolerable soil loss. This study sought to identify factors affecting community participation in ICM activities in Lekhobanyane catchment in Maseru district. The data collection for the study utilised the interview schedule targeting 95 household heads, randomly selected from 10 villages. Data analysis utilised logistic regression models to analyse the effects of multiple variables on the participation of the community in ICM. The findings have revealed that women and younger households with no employment participate more in ICM activities. The following factors gender, level of education, employment status, farming experience and access to extension services and frequency of extension visits influence participation in ICM programmes. The study recommends gender parity in decision making on ICM activities as this might help improve the quality of decision-making and ICM outcomes. Communities need assistance with innovations that reduce labour intensity, incentives to participate, knowledge and skills to facilitate participation in ICM. Efforts targeting the unemployed women, youths and household heads to participate in ICM should lead to significant positive increase in the implementation of ICM strategies.

IJSB
Accepted 19 July 2022
Published 23 July 2022
DOI: 10.5281/zenodo.6891101

Keywords: *Integrated Catchment Management, Lekhobanyane, community participation.*

About Author (s)

Moselantja Molaoa, Department of Agricultural Economics and Extension, Faculty of Agriculture, National University of Lesotho, Roma,180, Lesotho.

Brian Muroyiwa (Corresponding author)**,** Department of Agricultural Economics and Extension, National University of Lesotho, Roma, 180, Lesotho.

1. Introduction

Integrated catchment management (ICM) is the adoption of a holistic and integrated approach to the management of environmental hydrology for the regulation of water quality, soil quality, vegetation (dynamics) and land use. It uses a collaborative approach based on the hydrological boundaries of a catchment (Kelly *et al.,* 2013) to manage the landscape and natural processes (Rollarson *et al.*, 2018). It is a tool useful to improve land employed over decades in many continents including Australia, Africa and the USA. The basis for ICM approaches is on integration of community involvement, technical knowledge, organisational structure and policy objectives (Bellamy *et al.,* 2002). Its objective is to minimize land degradation by conservation and rehabilitation of the environmental resources to enhance biodiversity. Considering the high level of degradation in highland countries, the expectation is ICM measures will be a national priority in the improvement and conservation of natural resources for sustainable development and agricultural prosperity (Agidew and Singh 2018). Lesotho has been experiencing periods of drought and soil erosion that has caused serious land degradation since colonial administration in Africa (Singh 2000). The drought spells and climate change experienced in Lesotho are similar to the soil erosion phenomenon in Ethiopia (Drake and Bekele 2003). The reason being, erosion is more severe in the sloppy areas found in the highlands creating severe challenges such as reduction of available arable land and reduction in soil productivity that causes food insecurity. Lesotho has suffered severe degradation in both cultivated and rangeland, this can be noticed by severe soil loss in the form of gullies formation. Pelser and Letsela (2011) indicate that the main cause of soil erosion is sheet and wind erosion that affects both croplands and rangelands, causing both gully erosion and riverbank erosion. According to NES (2000), land degradation is weakening the land resource, which people depend on for their survival. Maro (2011) asserts that factors that increase soil erosion and environmental degradation in Lesotho are increasing human population, poor agricultural practices and land use, poverty and non-functional environmental policies. Natural vegetation in the form of grassland is characteristic of the environmental conditions and its steep slopes render it prone to land degradation and erosion by water (Pelser and Letsela, 2011). Removal of vegetation causes land deterioration, which leads to an increase in soil degradation that threatens water sources with the increase of floods and drought (Ministry of Water and Environment, 2014). It is important to consider ICM measures to reverse this degradation as they involve controlling the hydrologic and ecologic processes in the catchment to stop degradation by conserving and protecting water sources to prevent soil and vegetation loss. The Government of Lesotho has adopted and implemented the Integrated Catchment Management to rehabilitate the degraded land; under the responsibility of the Ministry of Forestry, Range and Soil Conservation. The government employs community members that it compensates financially who are responsible for small (micro) catchments rehabilitation employing conservation measures on degraded land to facilitate recovery. Non-Governmental Organisations (NGOs) and local communities integrate for proper attention to environmental degradation by contributing to land rehabilitation. The purpose is to rehabilitate arable land by controlling rainfall and runoff to improve infiltration, which results in a significant increase in plant production (Reij *et al.*, 2005). The strategy of ICM follows an area-based approach where districts develop plans in a decentralised programme so that local councils together with land managers identify and prioritize problems for possible technical interventions such as water harvesting and soil conservation structures. Environmental degradation and food security are the prominent challenges affecting humanity in the twenty-first century (Lal, 2000). Petja (2008) states that land degradation threatens approximately 16 percent of yields on pasture and croplands in Africa, which has reduced agricultural land. There is exacerbation of land degradation in Lesotho by a shortage of cropland and grazing area, which has resulted in low harvests and insufficient production of food for consumption forcing production for

subsistence purposes only. For this reason, many attempts have been engaged to reverse land degradation process and to promote sustainable land practices (Woodfine, 2013). However, the attempts differ in different communities according to the nature and cause of degradation. The aim of this study was to assess participation of communities in ICM, the expectation being contribution to environmental sustainability, ownership, protection and maintenance of the implemented assets, which is still a challenge in many areas in Lesotho.

2. Materials and Methods

2.1 Description of the Study area:

Lekhobanyane catchment is in Mazenod Community Council, at an average altitude of 1,582 m above sea level (Maro, 2011). It is located 20 km south of the capital Maseru, about 5 km from international airport. The catchment lies in the network of watershed of Phuthiatsana River. The dominant land-use type in the study area is settlements with houses scattered all over the catchment followed by field crops. Agriculture in the catchment comprises field crop production, livestock rearing and tree growing. The field crops production system focuses on production of cereals and pulses. There is a serious challenge of land degradation in the area due to soil erosion aggravated by overgrazing and poor farming methods. The predominant causes of land degradation in the catchment are overgrazing and poor farming practices that have caused irreversible damage to the landscape leading to growth of deep gullies, deterioration of rangelands and degradation of plant cover due to drought (Maro, 2011). The soil in the catchment is shallow, stony and rocky, which indicates poor drainage. The vegetation is thin and sparse, which is an indication of severe soil erosion. In this catchment, little vegetation is a sign of soil erosion which, initiated soil conservation measures to increase soil cover to enhance infiltration of water.

2.2 Research design

The study employed a descriptive quantitative research design to determine factors that influence participation in Lekhobanyane ICM programmes using a cross-sectional study design. The population of the study comprised community members of Lekhobanyane catchment, which mostly depends on agriculture as a source of livelihood. The study used stratified random sampling to classify the community into groups according to their village boundaries because village boundary is a natural unit in Africa; it is a tradition tool for management of communal resources (IFAD, 1992). There are ten (10) villages in the catchment that the study classified into strata. The researcher visited the chiefs to inquire and verify the number of households in the ten villages that are around the catchment. The study used simple random sampling to gather a sample of interviewees in each village based on proportional sampling informed by the number of households in each village in the catchment. The study gathered a sample of ninety-five (95) respondents selected from the population of two thousand (2000) households in the catchment, using Nassiuma's (2000) formula to determine the sample size.

2.3 Data collection

The survey instrument used for data collection was an interview schedule, where enumerator visited and interviewed randomly selected households. The data collection process involved the use of structured interviews with closed ended questions for data collection. In reference to the research plan, the basis of the sampling frame for the population was the number of households in the ten villages that constitute the catchment. The study utilised simple random sampling to select ninety-five (95) households from the study community followed by interviews to collect data from the sampled respondents. The study also used a questionnaire to collect data from three (3) land managers from the Ministry of Forestry and two (2) World Food Programme (officers responsible for technical work in the catchment).

2.4 Data analysis

The study made use of the binary logistic regression model to conduct analysis of data. In order to determine the factors that influence participation of community in ICM activities the study used the binary logistic regression model. Binary logistic regression model estimates the relationship between participation of community members in ICM and certain socio-economic characteristics of the respondents. Utilising the model, the study sought to determine the factors that influence participation in ICM in the context of individually specific data on multiple choices (Bekele and Drake, 2003). The dependent variable analysed in this study was the level of participation in ICM. Thus, community participation in ICM was measured as binary dummy variable (participate in ICM activities= 1, 0 = otherwise). If Y_i represent a dichotomous variable that equals 1 when the respondent has actively participated in the activity, otherwise 0. The probability of community member expressing active participation in ICM activities Pr (Y_i= 1) is a cumulative likelihood function evaluated at $X_i\beta$, where X_i is a set of explanatory variables and β is parameters to be estimated. For this study, the explanatory variables selected were demographic variables (age, household size and gender) and socio-economic variables (level of education, physical fitness, farming experience and employment status) and institutional variables (access to extension services, access to training material, acquisition of benefits and frequency of extension visits).

The study modelled the cumulative density/likelihood function using the following logistic probability function (Greene, 2008; Getacher and Tafere, 2013):

$$\Pr(Y_i = 1) = \frac{\exp(X_i\beta)}{1 + \exp(X_i\beta)}$$

$$Ln[\left(\frac{\Pr(Y_i = 1)}{1 - \Pr(Y_i = 1)}\right] = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots \ldots \beta_n X_n$$

$$Ln\left[\frac{\Pr(Y_i = 1)}{1 - \Pr(Y_i = 1)}\right.$$

$$= \beta_0 + \beta_1(\text{Age}) + \beta_2(\text{Gender}) + \beta_3(\text{Education}) + \beta_4(\text{Employment status}) + \beta_5(\text{Farming experience}) + \beta_6(\text{Physical fitness}) + \beta_7(\text{Access to extension}) + \beta_8(\text{Frequency of extension visits}) \ldots . + \beta_n X_n$$

Where: Y_i = a dichotomous variable that equals 1, if the respondent has actively participated, otherwise 0.

Pr =probability that i^{th} respondent had active participation
X_i=vector of explanatory variables (demographic, socio-economic variables)
β=parameters to be estimated.
Where β_0 is a constant

2.5 Independent Variables and Their expected Outcomes

Table 1 presents the dependent variable for the study and the choice of independent variables guided by literature. It shows the independent (explanatory) variables, their description and the expected outcome in relation to the dependent variable. The dependent variable is community participation which is 1 for participation and 0 for otherwise. The variable type for the explanatory variable age is continuous and the expectation is that it influences participation in ICM either positively or negatively. The independent variable gender is a categorical variable (dummy) coded with 1 if female and 0 if male. The expectation is that participation of females in ICM activities would be higher since women make up the majority of rural dwellers and are heavily involved in farming activities in rural areas. The postulation for the variables household size, employment status, farming experience, physical fitness, access to training material and acquisition of benefits is a positive influence on participation. Level of education, access to

extension service and frequency of extension visits affect participation either positively or negatively according to Table 1.

Table 1: variables used in binary logistic regression model

Variable name	Variable description	Variable Type	Measurement Unit	Expected sign
Dependent variable				
Y= community participation	Participate = 1 0 = otherwise			
Independent variable				
X_1 = Age	Age	Continuous	Number	+/-
X_2 = Gender	Gender	Dummy	1 if household head is male, 0 otherwise	+
X_3Household size	Household size	Continuous	Number	+
X_4 Level of education	Level of education	Categorical	1 if household head is literate 0 otherwise	+/-
X_5 Employment status	Employment status	Categorical	1 if unemployed 0 otherwise	+
X_6Farming experience	Farming experience	Continuous	Number	+
X_7 Physical fitness	Physical fitness	Dummy	1 if household head is male 0 otherwise	+
X_8 Access to extension services	Access to extension services	Dummy	1 if yes 0 otherwise	+/-
X_9 Frequency of extension visit	Frequency of extension visit	Dummy	1 at least once a month 0 otherwise	+/-
X_{10} Access to training materials	Access to training materials	Dummy	1 if yes 0 otherwise	+
X_{11} Acquisition of benefits	Acquisition of benefits	Dummy	1 if yes 0 otherwise	+

3. Findings and discussion

3.1 Summary of Socio-Economic Characteristics of Respondents

The socio demographic characteristics of the participants are in Table 2.

Table 2: Socio- Demographic characteristics of respondents

Variable	Class	Frequency	Percentage
Gender	Female	50	52.63
	Male	45	47.37
Age group	20-30	26	27.37
	31-40	26	23.37
	41-50	18	18.85
	51-60	17	17.89
	61-70	7	7.37
Level of education	No education	11	11.58
	Primary	44	46.32
	High school	34	35.79
	Tertiary	5	5.21
Household size	1-3	28	29.47
	4-7	56	58.95
	8-11	10	10.53
	12-15	1	1.05
Employment status	Not employed	83	87.37
	Formal Employment	2	2.11
	Informal employment	4	4.21
	Self employed	6	6.32
Farming experience	0-10	50	52.63
	11-20	16	16.84
	21-30	19	20.00
	31-40	7	7.37
	41-50	3	3.16
Physical fitness	Yes	93	97.89
	No	2	2.11

There were 52.63 female and 47.37 male respondents. These statistics are as expected since majority of rural population are females. The age of respondents ranges from 20 to 70 years. The respondents ranging from 20-50 years age group constitute 69.59% while 51-70 years age group constitute 30.41%. Farmers' age is a good proxy and determinant of the farming experience. The study revealed that 11.58% of respondents had no formal education. About 46.32% have obtained primary school education, while only 35.79% obtained high school level education. Furthermore, 5.21% have received tertiary education. Farming experience and employment status is as illustrated in Table 2. Majority of the respondents were physically fit and household size of 4-7 was the most prevalent household size in the study area accounting for 56 percent.

3.2 Results of Logistic regression model

Table 3 presents the results of the logistic regression model on the factors affecting participation of community in ICM. The results show that gender, level of education, employment status, farming experience and frequency of extension visits influences participation in ICM activities at 5% level of significance. Access to extension services is significant at 10 percent level of significance.

TABLE 3: factors affecting participation of community in icm

	Coefficient	Standard error	Z	P>(z)	95%	Interval
Gender	5.473458	4.529634	2.05	0.040**	1.081032	27.7131
Age	0.9709205	0.1705489	-0.17	0.867	0.6881201	1.369945
Household size	1.336637	0.7616868	0.51	0.611	0.4374751	4.083884
Level of education	2.988516	1.625431	2.01	0.044**	1.029186	8.677959
Employment status	3.14014	1.321217	2.72	0.007**	1.376591	7.162968
Farming experience	3.390119	1.37731	3.01	0.003**	1.528959	7.516819
Physical fitness	1.133001	3.72647	0.04	0.970	0.0017972	714.2567
Access to extension	1.875456	0.6755377	1.75	0.081***	0.9257732	3.799347
Frequency of extension visit	0.1462366	0.0822462	-3.42	0.001**	0.485651	0.4403325
Access to training materials	0.9516345	0.7669359	-0.06	0.951	0.1960987	4.618125
Acquisition of benefits	0.7598465	0.3605882	-0.58	0.563	0.2997677	1.926047
Constant	0.3176683	0.5465693	-0.67	0.505	0.0109	9.258113

**Level of significance is 5%.
***Level of significance is 10%.

LR chi2(11)	**=**	**41.04**
Prob> chi2	**=**	**0.0000**
Pseudo R2	**=**	**0.4260**
Log likelihood	**=**	**-27.650163**
Observations	**=**	**92**

3.2.1 Gender

Relationship between gender and choice of household head to participate in ICM is significant and positive. A unit increase in gender of the household head significantly increases the likelihood of participation by 5.47. This indicates that participation might improve with increased gender equality to provide equal decision-making between men and women (Musyoki *et al.*, 2016). Sell (1997) suggest that women co-operate well in mixed gender groups and men as well cooperate smoothly in a large female group because men influence group decisions about environment, as opposed to all-male group where all other members are equally powerful. The study had a greater number of female-headed household (52.63%) participating compared to male headed household (47.37%). Dolisca *et al.*, (2006), suggests that female farmers are more concerned with natural resources management and conservation practices because they do most of rural farming. Women forcibly have to play the role of the household head in the absence of their husbands (Maro, 2011).

3.2.2 Age of household head

The variable age of the household head is insignificant at all levels of significance. This finding implies that age of the household head has no effect on the decision to participate in ICM activities. All members of the community regardless of their age can participate in ICM activities. This is contrary to Dolisca *et al.*, (2006) who assert that young people are more willing to participate and contribute in decision making process that affect environmental programs. All age groups can participate freely in ICM activities according to findings of this study. However, younger age group of participants would be more likely literate than an older age group and the expectation is that the more educated the farmer the more they are willing to participate and want to learn new technologies.

3.2.3 Household size

The study findings indicate that household size is insignificant at all levels of significance. This finding suggests that household size has no effect on the decision to participate in ICM activities. This is contrary to Tadasse *et al.*, (2017) who indicated that increase in family size increased the level of participation in forest management programme. Tadasse et al. (2017) argued that this is because larger families have more labour force, therefore there is evidence that they participate more in forest management activities of the community than smaller families (Chhetri *et al.*, 2013). The assumption is that a larger family size would have a lower land/man ratio; making that an incentive to invest and participate in conservation activities (Bekele and Drake 2003). However, in a family with many people to feed there might be competition for labour between food generation and participation in soil and water conservation, diverting labour away from conservation activities that comparatively have longer-term effect. This could explain the insignificance of the household size in affecting participation ICM activities, furthermore the majority of household are not huge, which results in competition of labour between ICM activities and other income generating activities.

3.2.4 Level of education

Education has a significant influence on household head decision to participate in ICM. Results in Table 1 show that the relationship is positive, the implication is that a unit increase in education of the household head increases the likelihood of the household head participation by 2.99. Dolisca *et al.*, (2006) agrees that, education is one of the factors that stimulate local participation in several development and natural resource management initiatives. About 46.32% and 35.79% of the household heads have acquired primary and high school education respectively. Glendinning *et al.*, (2001), has reported that education influences farmers' participation in conservation and forest management. Respondents that possess primary education are more willing to participate in economic programs compared to illiterate farmers (Dolisca *et al.*, 2006). People who have acquired more education become aware of the potential benefits from a managed environment and this influences them to participate more than the illiterate (Napier and Napier 1991). Education and knowledge about environmental conservation enable people to have positive views; this improves their ability to participate in trainings offered so that they learn new skills and techniques. Training enhances level of farmers' participation in conservation activities (Musyoki *et al.*, 2016). With more knowledge, oftentimes the literate farmers become contact farmers for extension agents to help in information dissemination about agricultural technologies from government agencies (Tenge *et al.*, 2004).

3.2.5 Employment status

The prior expectation is that employment status of the household head would have a positive relationship on the choice to participate in ICM. A unit increase in the variable unemployed

household head significantly increases the likelihood of participation by 3.14. The study acknowledges that there is relationship between employment status and participation, Table 2 shows that 87.37% of respondents are unemployed. Sithole *et al*., (2014) found that household head with no other source of income participate more in agriculture activities a findings similar the results of this study. The community members in the area have no commitment to off-farm activities to earn salary, so they are available to participate in ICM initiatives. Dabi *et al.*, (2017) asserts that source of income is a major influencing factor for participation in ICM activities.

3.2.6 Farming experience

Household heads' experience in farming has a positive relationship with choice to participate in ICM activities. A unit increase in household head's farming experience significantly increases the likelihood of household participation by 3.390. Table three (3), indicate that just over half of the community members' farming experience (52.63%) range from 0-10 years, followed by those with 21-30 years' experience who account for 20% of the respondents. This study result is similar to findings of Etwire *et al.* (2013) that indicate that younger farmers with little farming experience are more innovative and are willing to risk and try out new concepts.

3.2.7 Physical fitness

The variable household heads' physical fitness is insignificant at all levels of significance. The descriptive statistics in Table 2 show that majority of the respondents are physically fit based on the participants' responses. The explanation for this could be the age distribution of respondents where the majority 50 years and below. Soil and water conservation work is labour intensive because it involves stone collection and soil bunds construction (Miheretu, 2014). This type of work requires physically fit people for the labour-intensive operations. Since, almost all the respondents attest to physical fitness it therefore makes physical fitness insignificant in determination of participation in ICM activities.

3.2.8 Access to extension

Access to extension services is associated with a positive effect on participation in ICM. A unit increase in access to extension services significantly increases the likelihood of the household head participation by 1.875. Bekele and Drake (2003) found that the degree of access to information from experts influences conservation decisions positively. Supply of information and availability of means of production encourages farmers to become involved in environmental conservation (Dolisca *et al.*, 2006). Access to information has a strong positive relationship with participation in watershed management programs. Usman *et al.,* (2018), confirmed this stating that provision of information creates awareness of land degradation impacts on natural resources and increases participatory action in watershed management projects.

3.2.9 Frequency of extension visit

The relationship between frequency of extension visits and choice to participate in ICM activities is positive. Therefore, a unit increase in frequency of extension visits significantly increases the likelihood of the household head to participate by 0.146. Bekele and Drake (2003) observed that farmers with frequent contact with extension agents and easy access to information concerning their problems, potential and performance in agriculture are likely to participate in development activities. Figure 5 showed that 92% of respondents access extension services through extension workers and they receive visits more than twice a month from the extension workers. The role of extension visit in the study area is to provide access and timely advice to the ICM implementing community in the catchment. Moges and Taye

(2017), indicated that farmers who have more contact with the extension workers acquire more information related to the benefits of ICM, implementation techniques and maintenance. Extension visits enhance awareness of the community and their ability to consult the right people when they encounter problems (Kumbhar *et al.*, 2012). Thus, farmers will have appropriate and useful information about the benefits of conservation technologies that will encourage them to participate.

3.2.10 Access to training materials

Household heads' access to training materials is insignificant at all levels in influencing participation in ICM. This is contrary to Bekele and Drake (2003) who argue that the more a farmer access advice on conservation issues, the more likely they will participate in building of conservation structures. The degree of access to information from the agricultural experts by farmers may influence the decision to participate in conservation activities. Access to training materials keeps farmers well informed and that helps them to make rational decisions and develop longer planning horizons. Government, technical and development partners have been investing in ICM activities for a number of years possibly ensuring ready availability of training materials. The ready availability of training materials might explain the insignificance of access to training to materials in influencing participation in ICM activities.

3.2.11 Acquisition of benefits

The variable household heads' acquisition of benefits is insignificant at all levels in influencing participation in ICM activities. The finding is contrary to Degeti (2003) that monetary benefits and access rights to environmental resources enhance participation of farmers in conservation activities. In addition, Degeti (2003) and Getacher and Tafere (2013) argued that farmers who acquired benefits from forest products showed more active participation in implementation of the program.

4. Conclusions and Recommendations

The results obtained from the study revealed that most household heads that participated in the ICM programme were women and youth who are middle-aged than those in the late ages. The reason being migration of men to Republic of South Africa, leaving women to work on the fields in the absence of their husbands. There is also high unemployment rate among the youth and the middle aged. Youths seem to be willing to participate in conservation activities because they depend on farming for living in the absence of off-farm income generating activities. The study investigated the factors that affect farmers' participation in ICM programs in Lekhobanyane catchment in Maseru district. Five variables in the logistic regression model were significant at 5 percent level of significance and influence the farmers' decision or choice to participate in ICM. Access to extension is significant at 10 percent level of significance. The binary logistic regression model indicated that the demographic (gender), socioeconomic variables (level of education, employment status and farming experience) and institutional factors (access to extension and frequency of extension visit) variables are major factors that affect decision of farmers to participate in ICM programmes. The other five variables in the logistic regression model that include age, household size, physical fitness, access to training materials and acquisition of benefits. Several households involved in ICM program proved to have members that are physically fit and had labour force to help carry out ICM activities. Farmers' participation is the cornerstone for soil and water conservation programs, to encourage participation; farmers should be motivated so that they could share information, which will enhance their ability to uptake important conservation practices. This enhances environmental problem-solving abilities of the community member, which in turn improves community's level of empowerment. Participation is important for successful acceptance of

programs that facilitate development of strategies to address soil erosion, drought and enhancement of rural livelihoods for reducing incidences of rural unemployment and poverty. Thus, policymakers and project designers need to consider these factors in the future in ICM implementation activities in order to improve the level of participation in environmental management activities. Evidence from this study showed that participants in ICM were mostly women, youth and middle age. In order to encourage ICM participation government need to target this group of households to afford them skills, which will earn them income. In addition, government can support participants with skills and technology that reduce workload to influence greater participation. It is also important for communities to understand the benefits that they would acquire from participation in ICM activities through training by private and public extension services providers. The results of the study have shown that access to extension services and frequency of extension visits increases the likelihood of community members' participation in ICM activities. Government, donors and development partners should invest in trainings and provision of training materials to educate community members suffering from land degradation in their communities. A clear appreciation of benefits from ICM activities would improve community members' participation. Government, the donor community and development partners should also provide the necessary incentives to enhance participation that might include monetary and non-monetary benefits.

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Cite this article:

Moselantja Molaoa & Brian Muroyiwa (2022). Factors influencing participation in Integrated Catchment Management programmes in Lesotho: The case of Lekhobanyane catchment.*International Journal of Science and Business*, *6*(1), 94-105. doi: https://doi.org/10.5281/zenodo.6891101

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