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Full Length Research Paper

Intervention designs for perceived improved access to farm productivity- enhancing resources in the drylands: Case study of Kenya

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In Kenya's dryland districts, gaps in access to productivity-enhancing resources are disconcertingly wide despite the growing number of external interventions. This research paper evaluates five past interventions to identify resource access gaps and effective designs replicable in the region. The study used cross-sectional data collected from sampled participants in each of the interventions. A two-stage regression model was used to assess the perceived effectiveness of the interventions. Results of the analysis showed that access to productivity-enhancing resources particularly irrigation, quality seeds, fertilizers and markets was patchy and low. Furthermore, access was significantly high where complementary resources could be found in a single intervention. Conclusively, resource planning should be an integral part of every intervention. Towards this end, irrigation and markets for credit and produce are critical. Moreover, use of the participatory intervention design is recommended in order to foster identification of complementary resources, which are relevant for specific socio-economic and natural contexts.

Key words: Intervention designsresource access, farm productivity, dryland, Kenya.

INTRODUCTION

Improving farm productivity in Kenya's drylands is essential for achieving household food security. It however presents a challenge, due to poor endowment of productivity-enhancing resources among farmers (Nyariki et al., 2002). Productivity-enhancing resources in this context refer to resources focused on increasing physical outputs such as fertilizers (Odhiambo et al., 2004; Jayne et al., 2004), irrigation technology and quality seeds (Bernbridge and Rossouw, 1993; Narayamoorthy, 2001), draught power (Guthiga, 2007), institutional resources constituting services such as markets for farm input and outputs (Narayamoorthy, 2001), road infrastructure (Narayamoorthy, 2001), extension services (Gok, 2001; Nyangito et al., 2004) and credit (Humberstone and Singer, 2006; Odhiambo et al., 2004).

External intervention has in the last decade played a key role in correcting the resource access disparities in the region. Yet, the persistent low farm productivity has one questioning the effectiveness of the interventions.

Social science links the effectiveness of an intervention to the design (Chambers, 1993; Mulwa, 2004). The design is defined here as the processes and strategies used to intervene in a situation. The intervention designs have historically evolved from conventional (top-bottom), through participatory (bottom-up) to mixed types (Mulwa, 2004). Proponents of the conventional designs view external intervention agents as 'experts' in development, who 'prescribe' development to the community (Escobar, 1995; Arce and Long, 2000; Hoff and Stiglitz, 2001; Adams, 2003; Gottret, 2007). Proponents of participatory designs discontent with the conventional approach. They argue that interventions fail because target communities are excluded in the decision-making. Mulwa (2004) for example points that even the intervener is an expert in his own domain. The design aims to enhance the sustainability of the development processes by strengthening institutional organization at the community

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level and, building linkages between the community and the formal institutional structures (Pretty, 1995). However, it has been criticized for being too costly in terms of time and finances (Gottret, 2007). Mixed-method intervention designs plan to optimize the outcome of interventions by integrating elements from the conventional and participatory designs (Ross, 1998). The need for integration has not been limited to processes but to strategies as well. The European Commission (2000) in particular stresses the importance of integrating conservation of natural resources with other farm production strategies.

Although, impact analysis has been widely discussed, empirical evidence on the performance of the different intervention designs in the field is limited and dependent on the regional context. In Latin America for example, Gottret and Raymond (2003) report success of the integrated approach. In the same region, the participatory approach is also reported effective (Gottret, 2007). Other studies report on the effectiveness of specific intervention strategies. For example, Wollni and Zeller (2007) and D'Haese et al. (2005) find a strong link between membership in local cooperatives and access to markets. In Kenya, Pretty and Scoones (1994) reports effectiveness of the participatory design on access to soil conservation resources. But similar results were also realized with the conventional design in a different location of the country (Tiffens et al., 1994).

It is evidently not clear what types of intervention designs are suitable for which kinds of social and economic contexts. Most of the designs are often dictated by the funding organizations and are often blamed for intervention failures (Anyang', 2007). It is hence critical to provide information on suitable intervention designs for specific regional contexts. The research in this paper seeks to identify effective interventions for resource dissemination in the drylands of Kenya. It evaluates and compares the impact of five different intervention case studies on resource access. Hypothetically, integrated participatory designs would be the most effective, based on strong support from intervention theory and empirical research (European Commission, 2000; Chambers, 1994; Mulwa, 2004; Gotrett, 2007).

The information is important for intervention planners, donors and agricultural extension service providers as a result of improved intervention designs. It can contribute towards improvement in the farm productivity of the region.

Case studies

The five selected interventions had all been implemented in Makueni district, one of Kenya's dryland districts. The district was selected on the criteria of having low farm productivity (Wanjama, 2002), and existence of many interventions from which a representative sample could be picked.

The intervention case studies were namely, Makueni Integrated Agricultural Project (MAP), International Crop Research Institute for Semi-arid and Arid Tropics Project (ICRISATP), Community Based Nutrition Project (CBNP), Kenya-Rural Enterprise Project (K-REP), and Kibwezi irrigation project (Irrigation). MAP sought to build the capacity of local community groups using participatory design and integrated strategies: soil and water conservation, water supply, veterinary services, enterprise development, nutrition education, agricultural technology improvement, seed banking and market integration. The intervention was expected to be effective because the design ensured that the resources disseminated were relevant to the community. Besides, a similar design is reported effective in West Africa (Guijt, 1992). The ICRISATP used a mixed design to develop and transfer drought-resistant crop technologies, and to link farmers to local output markets. The technologies were selected by ICRISAT staff but developed and tested on farmers' fields. Participation in the intervention was expected to increase adoption of the developed technologies and related resources such as fertilizers. Nzomoi et al. (2007) report improved use of production resources associated with better knowledge in farm technology. The CBNP had a mixed design, and was integrated, seeking to provide nutrition and health education, farming skills, as well as agricultural inputs to very poor households. Nutritional interventions have been shown to improve use of agricultural resources (Laurie and Faber, 2008).

The fourth intervention, K-REP, used a conventional design to provide business skills, savings and credit services to groups and individuals. Participation in K-REP was expected to improve access to credit and farm production resources. Credit programmes in Kenya have been shown to positively influence access to farm inputs (Ouma et al., 2002). The fifth intervention, irrigation, employed a conventional design to transfer irrigated horticulture production technology to farmers. Narayamoorthy (2001) links access to irrigation with access to other farm resources; and participation in the intervention was expected to have impact in the access to a wide range of resources.

RESEARCH METHOD

Research design and data

The research used ex-post evaluation design, which involves comparison of "with"- and "without"-intervention scenarios (Ravallion, 2001). In this case, a control group consisting of those who did not participate in the intervention is used to construct the "without"- intervention scenario (Heckman, 1997; Ravallion, 2001).

Past ex-post evaluations have used one-dimensional comparison to identify effectiveness of single interventions. This research however uses two-dimensional comparison involving multiple intervention case studies to identify the most effective design.

A two-step sampling procedure was used to ensure representativeness. In the first step, the five intervention cases were purposefully selected to represent the three different designs and also the district locations. An additional group, the control, was randomly selected from non-intervention participants in the district. In the second step of the sampling, a representative sample of 191 households was randomly selected, 134 from the five interventions based on a list of ex-participants, and 57 from the non-participating population. The household was used as the unit of study because the interventions were targeted at household level.

Data for analysis was obtained from household cross-sectional survey undertaken between June, 2005 and September, 2006. The selected households were addressed with structured questionnaires covering household characteristics and perceived resource access. Respondents were asked if they had (or not) adequate access to a list of productivity-enhancing resources given in the introduction section. Information on the type of intervention designs was collected from intervention reports supplemented with unstructured questionnaires addressed to the respective intervention managers.

Empirical analysis

The objective of the empirical analysis was to identify whether there were significant differences in access to resources between intervention participants and non-participants; establish that the differences were solely due to participation, and not any other factor; and to determine which interventions were effective in what kinds of resources, and under what circumstances. The households were categorized into participants, coded one and non-participants coded zero and compared in terms of resource access. The comparison was split in two main steps: descriptive (comparison of means) and econometric (regression).

Descriptive analysis

The descriptive analysis was done to determine whether the mean resource access in each intervention differed from that of the control group (Gupta, 1999). Resource access was given a value of one if a household had sufficient access and zero otherwise. Access rates were computed as the proportion of those having sufficient access within an intervention group. The mean access rate (percent) for each intervention was made and statistically compared with that of the control group.

Regression analysis

A regression model was used to determine whether participation in the interventions was attributable to any differences in resource access observed in the descriptive analysis. There may be unobservable factors that increase the likelihood of participating in an intervention as well as influencing resource access. People who participated in the interventions might as well have achieved the same resource access rates even if they had not participated. In this case, a simple regression of resource access rate on the binary participation variable would overestimate the intervention effectiveness. The following standard treatment effects model is used as control for this sample selection bias (Imbens, 2004).

$$Y_i = \beta X_i + \delta I_i + \mu_i \quad (1)$$

$$I_i^* = \alpha Z_i + \varepsilon_i \quad (2)$$

$I_i = 1$ if $I_i^* > 0$, otherwise $I_i = 0$,

Where, Y_i is the access rate of a particular resource; X_i is a vector of variables thought to affect access; I_i is the dummy for participation in an intervention; and Z_i is the vector for the variables influencing participation; μ_i and ε_i are the error terms.

The base Equation (1) cannot be estimated directly because the decision to participate may be determined by factors, which also affect resource access. In this case, the error terms, μ_i and ε_i in the two equations will be correlated, leading to biased estimates on the participation parameter δ (Ravallion, 2001; Imbens, 2004). The selection bias can be corrected by assuming a joint normal error distribution and using a two-step procedure. In the first step, the decision to participate in the intervention was modeled based on Equation (2). In the second step, residuals from the participation regression (probability participation) were used in the base equation (Ravallion, 2001). The specification of the regression functions used is described below.

***Model specification for participation*:** A logistic function was used to model participation. It was selected because firstly, the data was dichotomous and secondly, normality in distribution of the data could not be assumed (Gupta, 1999; Greene, 2000). The logistic function is widely applied in binary response studies (Boz et al., 2005; Nzomoi et al., 2007). The variables for the model included attributes of the intervention and individual characteristics of participants. The intervention attributes should be constant among participants, controlling for socio-economic characteristics of households (Wollni and Zeller, 2007).

The decisions to participate in an intervention and to acquire resources are likely to be influenced by the same factors. Introducing the variables in the two models would cause simultaneity bias in the estimation (Imbens, 2004). To correct the bias, instrumental variables were used. By implication, the instrumental variables are excluded in the second regression (Lee et al., 2005). The instrumental variables used were: location (proximity of the participant to the intervention offices measured), the age of household head and the number of unemployed adult children in the households (as proxy for labour). All the three variables were expected to have a positive influence on participation (Pitt et al., 1993).

Model specification for determination of intervention impacts: For reasons similar to the modeling for participation, a logistic function was also applied for the analysis of the determinants of resource access. Access to a given resource was modeled as the dependent variable while explanatory variables were: education level of household head; household size, cropped area and the predicted probabilities of participation derived from the participation regression. To ensure common support in controlling for selection bias, the units with a probability of participation coefficient equal to zero were excluded from the analysis (Ravallion, 2001).

The predicted probabilities of participation were expected to have positive and statistically significant coefficients indicating effectiveness of the intervention in securing access to resources. The level of education and cropped area were expected to positively affect participation (Warnings and Key, 2002; Lee et al., 2005; Nzomoi et al., 2007).

Access to certain resources such as irrigation and fertilizers can overlap and can, if entered in the same regression cause multicolinearity (Nzomoi et al., 2007). To avoid the problem, each resource was analyzed separately. Only the resources in which the interventions had shown mean access rates statistically higher than

Table 1. Distribution of variables used in the study (Means and Standard deviation in parenthesis).

N	MAP 29	ICRISATP 25	CBNP 28	K-REP 29	IRRIG. 23	Control 57
Location (km)	12.7(2.7)	20.7(6.3)	11.2(3.7)	12.0(2.7)	36.0(16.0)	69.0(54.0)
Gender (1= female)	0.14(0.3)	0.20(0.4)	0.37(0.5)	0.27(0.4)	0.13(0.3)	0.22(0.4)
Age (years)	53.3(12.3)	47.5(9.6)	53.5(15.6)	52.1(13.1)	40.1(9.3)	43.0(10.2)
Education level (years)	9.6(3.4)	7.6(3.6)	6.0(4.8)	6.9(4.1)	7.7(2.7)	6.9(2.3)
Number unemployed adults children	0.6(1.1)	1.0(1.1)	1.4(1.2)	1.3(1.4)	0.4(0.8)	0.9(1.1)
Household size (adult equivalents)	4.2(1.3)	4.6(1.8)	5.7(1.7)	5.5(1.5)	3.9(2.1)	4.3(1.8)
Cropped area (acres)	5.4(4.4)	4.1(2.5)	3.1(1.4)	3.6(1.9)	2.1(1.6)	3.3(2.1)

that of the control group in the comparison of means were used in the analysis.

RESULTS AND DISCUSSION

The distribution of the explanatory variables is summarized in Table 1. There were no statistically significant differences in the means of the variables between intervention participants and the control group.

Comparison of means

Table 2 presents the mean access rates of the 11 resources studied across the five interventions and the control group.

The results show that mean resource access in the intervention groups was generally higher than in the control group. With regard to the specific interventions, the results suggest that MAP was effective in securing access to extension services (69%), water supply (48%), quality seeds (72%), veterinary services (62%), produce markets (79%) and draught power (83%). The results of ICRISATP and CBNP interventions were suggestive of ineffectiveness, with access rates relatively higher than the control only for extension services (64%), respectively. The results of K-REP suggested effectiveness in veterinary services (45%), credit and savings (69 percent), development of SMEs (83 percent), and draught power (57 percent). Finally, Irrigation intervention showed higher access rates than control for all the resources measured except water supply and nutrition and health education; and were suggestive of effectiveness in resource dissemination.

The descriptive observations show high effectiveness in MAP, Irrigation and K-REP interventions. They are however inconclusive since the analysis does not control for the effects of confounding factors. A two-stage regression was run in which confounding factors in resource access and intervention participation were taken into account and the determinants of resource access identified.

Determinants of intervention participation

Results of the first-step regression on determinants of intervention participation are shown in Table 3.

The models for participation in the interventions were all valid as indicated by the highly significant chi-square values ($p < 0.01$); and correctly predicted over 76% of the outcomes. Proximity of households to the intervention's administration offices increases the probability of participation. The effect of the other variables was only observed in the MAP intervention. Households with older heads and less unemployed adult children were more likely to participate.

Observed positive correlation between participation and proximity could be explained by the principle of transaction costs (Pitt et al., 1993). Closely located households have relatively lower costs in terms of transport and time and are therefore more motivated to participate than those far. For MAP, the observed positive effect of age on participation could be due to the intervention's cost-share element. Bell et al., 1994) report a positive correlation between age and participation in cost-share programmes, particularly for educated participants. Such farmers are able to understand the benefits of participation as well as afford the costs-sharing. But it could also be due to the design of the intervention, which promoted soil and water conservation. Such programmes are reportedly popular among the relatively aged households in Kenya (Pretty and Scoones, 1994). The negative effect of the number of unemployed adult children on participation was unexpected. It could be linked to the cost-share element of the intervention which may have encouraged

Table 2. Statistical comparison of resources' access rates (percent) between intervention groups and the control group.

	Extension services	Water supply	Quality seeds	Cash cropping	Veterinary services	Nutrition and health	Credit and savings	Irrigation	Produce markets	Development of SMEs	Draught power
MAP (N = 29)	69	48	72	24	62	10	34	10	79	21	83
ICRISATP(N = 25)	64	24	16	8	20	20	16	20	16	20	40
CBNP (N = 28)	64	14	25	36	32	43	14	14	21	18	36
K-REP (N = 29)	41	24	45	17	45	17	69	18	17	83	57
Irrigation(N = 23)	82	17	91	86	43	22	74	83	91	39	65
Control (N = 57)	21	16	26	11	12	16	14	12	12	18	33

Table 3. Logit model for participation in an intervention (standard errors in parenthesis).

N	Interventions				
	MAP 29	ICRISATP 25	CBNP 28	K-REP 29	Irrigation 23
Location (km)	- 0.32[1] (0.1)	- 0.10[2] (0.0)	- 0.23[2] (0.1)	- 0.18[3] (0.1)	- 0.05[3] (0.0)
Age (years)	0.10[2] (0.0)	0.04 (0.0)	0.07 (0.0)	0.05 (0.0)	-0.05 (0.0)
Unemployed adult children (number)	-1.1[2] (0.5)	0.037 (0.2)	0.174 (0.3)	0.060 (0.3)	-0.432 (0.4)
Constant	1.24 (3.1)	0.329 (1.5)	-0.163 (1.9)	0.694[3] (1.7)	4.8[3] (1.5)
Model summary					
Chi-square	71.9[3]	30.9[3]	61.8[3]	52.1[3]	35.2[3]
-2 log likelihood	(38.1)	(69.9)	(43.5)	(57.8)	(60.7)
Negelkerke's R^2	0.785	0.443	0.732	0.630	0.509
% correctly predicted					
0	89.5	82.5	83.3	77.2	87.7
1	89.7	64.0	85.7	82.8	56.5
Total	89.5	76.8	84.1	79.1	78.8

1, 2 and 3 refer to statistical significance at 99, 95 and 90%, respectively.

participation by the relatively less poor households. Logically, these would be the households experiencing relatively less unemployment.

The impact of intervention participation on resource access

Results of the second-step regression on determinants of resource access are shown and discussed separately for each intervention. It should be noted that the analysis was limited only to the resources in which the intervention

Table 4. Effectiveness of MAP (coefficients and standard errors in parenthesis).

N = 46	Water supply	Quality seeds	Veterinary services	Produce markets
Education level (years)	-0.05(0.1)	-0.03(0.1)	0.068(0.1)	0.192(0.1)
Cropped area(acres)	-0.12(0.1)	0.13(0.1)	0.134(0.1)	-0.023(0.1)
Household size(number)	0.27(0.2)	-0.08(0.2)	0.199(0.2)	0.183(0.2)
Probability participation	2.93(0.9)^3	1.72(1.3)^3	1.52(0.7)^2	2.74(0.8)^3
Constant	-2.57(0.9)^3	-0.91(1.4)	-3.19(0.9)^2	-2.11(0.8)^2
Model summary				
Chi-square	13.8^3	10.8^2	14.6^3	18.6^3
-2loglikelihood	86.1	106.0	95.3	98.8
R^2 (Nagelkerke)	0.220	0.160	0.217	0.262
% correctly predicted				
0	90.5	78.0	86.0	77.6
1	34.8	52.8	34.5	62.2
Total	75.6	67.4	68.6	70.9

1, 2 and 3 refer to statistical significance at 99, 95 and 90 percent respectively.

Table 5. Effectiveness of ICRISATP (coefficients and standard errors in parenthesis).

N = 82	Extension services
Education	0.04 (0.1)
Cropped area	0.03 (0.1)
Household size	0.06(0.2)
Probability participation	2.14 (1.0)^2
Constant	-1.89 (0.9)^2
Model summary	
Chi-square	10.3^1
-2loglikelihood	98.8
R^2 (Nagelkerke)	0.184
% correctly predicted	
0	90.7
1	42.5
Total	66.6

1, 2 and 3 refer to statistical significance at 99, 95 and 90%, respectively.

indicated significantly higher rates than the control (Table 3).

Impact of MAP

Table 4 presents results of the logit regressions for the resources in MAP. The models were statistically valid and had good predictive ability. Of the several variables that could explain the probability of resource access, the probability of participation was the most significant. It significantly increased the probability to gain adequate access to water supply (P < 0.01), quality seeds (P <0.01), veterinary services (P < 0.05) and market for produce (P < 0.01).

The results clearly indicate that MAP intervention was effective in increasing access to the four resources. The effectiveness could be attributed to the intervention's integrated design that used participatory tools on community groups. Participants could gain access to a wide range of resources, compared to the non-participants. Dercon (2003) stresses the importance of the integrated participatory design; and Guijt (1992) report success of a similar approach in Burkina Faso.

Impact of ICRISATP

Results for the logit model for testing the impact of participation in the ICRISATP on access to extension are shown in Table 5. The model was significant, and 74.4% of the observations were correctly predicted. The results show that only the probability of participation was significant (P < 0.01). Household and farm characteristic did not show significant effect.

The low perceived effectiveness of ICRISATP in access to resources could be linked to its design. The mixed but predominantly conventional top-down approach used by the ICRISATP implied that the dryland crop technologies developed were pure initiative of the project without community participation. The technologies were hence outside the interest of the community, as reported by some participants during the interview. Asked what their expectations of the intervention were, some said they expected to have been supplied with quality maize and beans seeds. Lutta (1993) reports that farmers in Makueni were not interested in new drought-resistant crop technologies because they were considered inferior to the local varieties.

Table 6. Effectiveness of the CBNP (coefficients and standard errors in parenthesis).

N = 82	Extension services
Education	-0.05 (0.1)
Cropped area	-0.12 (0.1)
Household size	-0.011(0.2)
Probability participation	2.70 (0.7)^3
Constant	-1. 22(0.76)
Model summary	
Chi-square	16.6^2
-2loglikelihood	93.9
R^2 (Nagelkerke)	0.248
% correctly predicted:	
0	75.5
1	63.6
Total	70.7

1, 2 and 3 refer to statistical significance at 99, 95 and 90%, respectively.

Table 7. Effectiveness of K-REP (coefficients and standard errors in parenthesis).

N = 86	Credit	Business skills
Education	0.07(0.1)	-0.03(0.1)
Household size	-0.16(0.2)	-0.21(0.2)
Cropped area	0.19(0.2)	0.19(0.1)
Probability participation	2.17(0.6)^3	2.61(0.9)^3
Constant	-1.18(0.7)	-1.11(0.7)
Model summary		
Chi-square	18.7^3	21.1^3
-2loglikelihood	91.9	95.2
R^2 (Nagelkerke)	0.263	0.293
% correctly predicted		
0	84.2	74.5
1	44.8	62.9
Total	70.9	69.8

1, 2 and 3 refer to statistical significance at 99, 95 and 90%, respectively.

Impact of CBNP

Results of the logit model for determinants of resource access under the CBNP are summarized in Table 6. The model was valid ($P < 0.05$) with 70.1% of the cases correctly predicted. Participation in the intervention was only effective in access to extension services, indicated by the significant coefficient on the probability of participation in the project ($P < 0.01$).

The low effectiveness of the CBNP on resource access was surprising, considering that the resources it was disseminating (health and nutrition education, quality seeds and draught power) were relevant to the area (Gok, 2001). The problem was assumed to lie with the conventional intervention design which did not address the key resources limiting productivity. The assumption was confirmed by participants during the interview. When asked to state the problems experienced during the intervention, 50% of them quoted rainfall failure. Others said they had expected that the intervention would assist them to access irrigation. The project had not undertaken participatory needs assessment to prioritize community needs. The resources provided could be said to have been incomplete in the sense of not being complementary. Nutrition education and agricultural trainings have been found to complement each other where crops could effectively be grown under rain or irrigation (Laurie and Faber, 2008; Low et al., 2007).

Impact of the K-REP Bank

Results of the logit models for identifying determinants of resource access in the K-REP are summarized in Table 7. The results show that the probability of participation in the intervention had significant effect on the access to credit and business skills ($p < 0.01$).

The effectiveness of K-REP could be attributed to its design, which, although conventional, exploited the existence of local groups. Local groups can provide social capital, which enhances access to certain resources, credit for example. The interventions also seem to have recognized the complementary nature and relevance of the resources intervened. Gayle and Barness (2005) for example link improvement in business skills with loan repayment. Contrary to expectation, however effectiveness in access to credit did not lead to significant use of quality seeds and fertilizers. The reason could be due to a weakness in the design. The bank required weekly repayments of the loans. Besides, the loan amounts were reportedly too small, and grace period too short to take advantage of price differentials under agriculture. Consequently, most of the loans were extended to small enterprises, and marginalized purely subsistence farmers. The observation echoes that of other research. Wampfler (2003) for example, asserts that “microcredit is beneficial to non-agricultural enterprises”. Low et al. (2007) also report that microcredit did not respond to the specificities of agricultural demand.

Impact of irrigation

Results of the regression models to identify the determinants of resource access in the irrigation intervention are shown in Table 8. Each of the models was valid, as indicated by the statistically significant chi-square values ($P < 0.01$).

The coefficients on the variable probability participation

Table 8. Effectiveness of the Irrigation project (coefficients and standard errors in parenthesis).

N = 80	Extension services	Quality seeds	Fertilizers	Credit services	Irrigation facility	Produce markets
Education	0.08 (0.1)	0.11 (0.1)	0.01 (0.1)	0.12 (0.1)	0.11 (0.1)	0.01 (0.1)
Household size	-0.12 (0.1)	0.12 (0.1)	-0.42 (0.2)[2]	-0.41 (0.2)[2]	0.02 (0.2)	0.33 (0.2)
Cropped area	0.09 (0.1)	-0.18 (0.1)	-0.07 (0.2)	0.11 (0.1)	-0.46 (0.2)[2]	-0.29 (0.1)[1]
Probability participation	2.60 (1.0)[3]	1.94 (1.0)[2]	4.15 (1.2)[3]	2.30 (1.1)[2]	1.97 (1.1)[1]	0.68 (0.1)
Constant	-1.43 (0.8)[1]	-0.79 (0.7)	-0.37(0.8)	-0.67 (0.8)	-0.74 (0.9)	-0.40 (0.74)
Model summary						
Chi-square	10.4[2]	8.4[2]	23.7[3]	15.4[3]	19.5[3]	11.9[3]
-2loglikelihood	96.3	101.9	72.3	86.9	81.4	97.7
R^2 (Nagelkerke)	0.162	0.130	0.363	0.243	0.302	0.186
%correctly predicted						
0	83.7	75.0	93.0	90.6	88.9	80.0
1	48.4	55.6	65.2	33.3	53.8	57.1
Total	70.0	66.3	85.0	71.3	77.5	70.0

1, 2 and 3 refer to statistical significance at 99, 95 and 90%, respectively.

were statistically significant for extension services ($P < 0.01$), quality seeds ($P < 0.05$), fertilizers ($P < 0.01$), credit ($P < 0.05$) and irrigation ($P < 0.1$). The results also show that small-sized households had a higher probability of having access to fertilizers and credit services ($P < 0.05$), respectively. Similarly, cropped area was negatively related with the probability to access irrigation ($P < 0.05$) and markets ($P < 0.1$).

The evident success of the irrigation intervention could be attributed to its strategy of producing commercial horticulture. The irrigation strategy addressed core production uncertainty associated with drought. It also motivated participation of other organizations and resource providers such as contracting companies and the Ministry of Agriculture who provided complementary resources such as technical services, input-credit and marketing services. The observed positive correlation between irrigated horticulture production and resource access confirms other studies in Kenya. Nzomoi et al. (2007) report wide access to production resources in the horticultural export industry, while earlier, Dijkstra (1997) had attributed the success of the irrigated horticulture export to high profitability.

The observed effect of small household size on the probability to access credit and fertilizers concurs with Nzomoi et al. (2007) and could be linked to relative poverty. In Kenya, large household size is correlated with poverty, which in turn is linked to inability to borrow (Nyangito et al., 2004). The negative relationship between the cropped area and access to irrigation and markets could be explained by the observation that irrigation was found in relatively small land parcels. Furthermore, only farmers cultivating horticultural crops had access to markets.

CONCLUSIONS AND POLICY IMPLICATIONS

The objective of the research in this paper was to identify the intervention designs effective in enhancing resources for farm productivity improvement in the dry-lands of Kenya. Although the research used case-study evaluation, which limits generalization of the conclusions, the comparison of multiple intervention designs enabled lessons to be drawn from a wide perspective. The findings are relevant to individual interventions and to intervention planning in general.

Results of the participation model showed that proximity to the intervention offices is a key variable in the decision to participate. It implies that decentralization of interventions should be given significance in intervention planning so that resources are brought closer to the community.

Results of the resources access models have shown that participants in interventions have in general higher resource access rates than non-intervention participants, especially extension services, which is the main focus of intervention in the study area. Nevertheless, adequate access to critical resources: water, quality seeds, fertilizers, credit and markets is patchy, minimal and largely dependent on the design of the intervention and the package of resources being disseminated.

Results from the K-REP and Irrigation intervention showed that dissemination of complementary resources enhances effectiveness, while observations from the ICRISATP and CBNP interventions had the opposite message. The implication to policy and other interventions is to undertake resource planning in the intervention designs. Towards this end, irrigation and markets for credit and produce are critical. Moreover, the use of participatory intervention design is recommended, in order to foster identification of complementary resources, which are relevant for specific socio-economic and natural contexts. Although the analysis has painted a picture of strategies that could reinforce resource access for productivity improvement in Kenya's drylands, understanding the strategies, which lead to significant improvements in farm productivity is essential and should be the subject of future research.

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