THE ROLE OF RISK IN ENTERPRISE SELECTION IN GITHUNGURI, KIAMBU DISTRICT

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Abstract
Kenya is currently not able to meet all the appropriate food needs for its population. Agricultural productivity is on the decline despite the many technologies developed by research institutions and the application of various dissemination approaches. Soil fertility is also declining due to nutrient mining occasioned by lack of sufficient surplus income to replenish. The objective of this study was to (i) determine current production patterns for farmers in Kianjogu focal area, Githunguri division, Kiambu district; (ii) develop risk efficient farm plans and compare these with farmers' plans in a bid to determine the role of risk in enterprise selection. Risk coefficients for farmers were obtained using a modification of linear programming model called Target-MOTAD, which assumes that a farmer minimises the probability of his farm output, hence income, falling below his subsistence requirements (safety-first hypothesis). From the optimal, and risk efficient and farmers current production plans, dairy is an important enterprise. Though the risk efficient plans are not feasible, as the income is less than the farmers' targeted income, the net returns are still higher than from current production plans. Farmers could be engaging in more activities in a bid to meet this deficit. From the study, it is evident that researchers and extension should focus technology dissemination in a way that does not compromise farmers current priority enterprises. Farmers are rational and may make a choice not to adopt activities that come in direct conflict with their subsistence requirements.

Introduction
Currently, Kenya is not able to meet all the appropriate food needs for its population. The food insecurity has been attributed to a number of factors, among them, fragile ecosystems and a steady decline in the growth of the agricultural sector. Population pressure and slow growth in other sectors of the economy have led to gradual degradation of the natural resource base through soil erosion and fertility depletion, forest destruction amongst others (MoALD, 2003). Whereas numerous technologies have been developed to curb soil fertility depletion as well as low productivity, adoption remains low and soil nutrient depletion is on the rise and productivity on the decline. Adoption studies have been conducted to determine the reasons for this. Farmers' perception of a technology is one reason that has been advanced by many authors as contributing to low adoption. Murwira (2003) advises that rather than giving one option to farmers, a basket of options should be availed and farmers allowed making their choice. Various authors suggest that subsistence farmers' attitude towards risk is to first grow crops and raise livestock that they expect, from experience, to guarantee provision of minimum income needed for their family's survival (Tauer, 1983, Adubi, 1994). Hence, to move from subsistence to more productive commercial farming, it is important for researchers to target enterprises that have higher chances of drawing farmers' interest.

Objectives
The overall objective of this study was hence to examine the role of risk on small-scale farmers' enterprise selection decisions and hence income. Specifically, the study sought to (i) determine current production patterns for farmers in Kianjogu focal area, Githunguri division, Kiambu district; (ii) develop risk efficient farm plans and compare these with farmers' plans in a bid to determine the role of risk in enterprise selection.

Methodology
The study was conducted in Kianjogu focal area, Githunguri division Kiambu district. The area is a coffee/dairy zone (Jaetzold and Schimdt, 1983). Soils are characterised as humic Nitisols, which are well drained and extremely deep. The soils are also characterised by high nutrient availability and high moisture storage capacity but the nutrient levels have been declining over the years due to insufficient replenishment. The farmers in the study area classified themselves into 3 soil fertility management classes namely, good (1), average (2) and poor (3) soil fertility managers. This study focused on class 2 farmers as they formed 50% of the 300 farmers in the area. Average farm size for this class of farmers was 0.76 ha (*SD = 1.01*).

Questionnaires were administered to 33 farmers in class 2 (22%) (Casley and Kumar, 1988). Data collected included information on priority enterprises, input and output as well as production patterns. Information on the alternative sources of income, and recurrent monthly expenditure on food and non-food requirements was also collected. The non-food requirements include expenditures on fuel wood, medical, school-fees and clothes.

The average per hectare expenditure and output/income was determined through gross margin calculations. Risk coefficients for farmers were obtained using a modification of linear programming model called Target-MOTAD, which assumes that a farmer minimises the probability of his farm output, hence income, falling below his subsistence requirements (safety-first hypothesis).

The Target-MOTAD model was given the following specification as adapted from Adubi, (1994) and Tauer (1983):

$$MaxTGM = \sum_{j=1}^{n} c_j x_j \quad (1)$$

subject to:

$$\sum_{j=1}^{n} a_{ij} x_j \leq b_i \qquad \text{for all } i = 1, 2, \ldots\ldots, m \quad (2)$$

$$T - \sum_{j=1}^{n} c_{rj} x_j - y_r \leq 0 \qquad \text{for all } r = 1, 2, \ldots\ldots, s \quad (3)$$

$$\sum_{r=1}^{s} p_r y_r = \lambda \qquad \lambda = M \rightarrow 0 \quad (4)$$

$$x_j, y_r \geq 0$$

The total gross margin (TGM) is calculated for various enterprises/activities. x_j are the real activities undertaken and form the column vector. These were maize, maize/beans, bananas, potatoes, tomatoes and dairy/Napier based on farmers' priorities. c_j, (coefficients of the objective function) are the unit profits from each enterprise and form the row vector. b_i are the resource constraints level. These were land, labour and operating capital. Input-output matrix, $a_{ij,}$ refers to the amount of resources *i(land, labour and capital)* for each activity *j*. These were determined from farmers through questionnaire administration and were the respective inputs required for 1 ha of specific enterprise production. *m* and *n* are the number of constraints and activities respectively. *T* is the target level of return/income determined from the food and non-food requirements per season. *T* was determined as the minimum target of income that farmers seek to attain their subsistence requirements. c_{rj} is the long-term return of activity j for state of observation r. Here average gross margin matrix for 8 years (1994 – 2002) was used to determine the risk factors. The 3 states of observation *r* were defined as the above average, average and below average annual rainfall as observed in the last 8 years in the study area. y_r is the deviation below T for state of observation r, calculated by the model. p_r is the probability that state of nature or observation r will occur. The probability was determined by comparing the rainfall figures for the 8 years to the average long-term rainfall of the study area. λ is a constant parameterised from M to 0. This constant gives the absolute value of expected negative deviation from the target return level. *s* number of states of nature or observations, which in this study will be the 3: wet, normal and below normal rain years. *M* is a large number (represents the maximum total absolute deviation of return of the model). x_j, $y_r \geq 0$ are the non-negativity constant. Coefficient of variation (expressed as a percentage) was used to compare risk levels across the different plans by dividing the standard deviation by the mean income.

Kurosaki (1997) indicates that income risk is dependent on both price and yield especially for rainfed agriculture and an increase in this risk is a loss of welfare to risk-averse households. He concludes that risk-averse farmers are interested in the combination of price and yield hence income. Increased income risk can make modern production technologies less attractive to these farmers and subsequently delay agricultural development. This study focussed on income risk.

Table 1–A Target-MOTAD tableau for the Kianjogu focal area Class 2

	Crop Activities (ha)						Negative Deviations from the Target (KES)									
Rows	X1	X2	X3	X4	X5	X6	Z1	Z2	Z3	Z4	Z5	Z6	Z7	Z8	Z9	RHS
Objective function (KES)	18,948	22,406	18,852	17,049	104,199	99,633										Maximise
Land (ha)	1	1	1	1	1	1										≤0.76
Labour (mandays per ha)	21	25	20	25	142	83										≤109
Capital (per ha)	8,169	9,244	1,550	16,037	62,966	25,850										≤46,595
Expected shortfall from target (KES)							0.09	0.14	0.06	0.14	0.06	0.14	0.09	0.14	0.14	
Risk rows (KES):																
1994	38,609	29,668	12,354	27,500	58,261	77,029	1									≥93,190
1995	14,636	31,255	13,200	22,163	45,640	76,338		1								≥93,190
1996	10,621	11,969	19,541	23,659	80,170	66,971			1							≥93,190
1997	26,618	25,641	24,162	47,051	68,825	94,618				1						≥93,190
1998	8,186	11,346	12,987	23,052	73,263	83,153					1					≥93,190
1999	20,499	22,596	17,551	28,051	159,503	112,064						1				≥93,190
2000	10,305	13,126	16,543	54,997	97,919	85,395							1			≥93,190
2001	7,324	8,934	10,188	86,517	119,701	105,501								1		≥93,190
2002	9,095	9,940	11,794	16,808	108,659	114,124									1	≥93,190

Target income = KES.93,190

Results and Discussion

At least 67% of class 2 households interviewed were male-headed. Average household expenditure was KES.93,190 p.a. Food expenditure was approximately KES.40,388 p.a translating to KES.23,298 per household adult equivalent p.a. for an average of 4 (*sd=2)* adult equivalent[1] per households ranging from 1 to 13 persons per household. An average SFM class 2 farmer attained an average income of KES. 35,656 per season from 0.76ha of land (appx KES.5,950 per month), from falling below the average household expenditure.

Risk minimized plans for class 2 incorporated only tomato and dairy production. As the expected shortfall (negative deviation) from target income increased net income from the risk minimised plans II to IV increased by only KES. 2000 while area under tomato increased to 82% of total farm area. At zero-risk, an income of KES.79,000 was obtained.The coefficient of variation was higher for farmers' production practice as compared to risk plans II to IV. This means that the farmers' production practices during the study year were riskier than those depicted in plans II to IV. Allocating more area to dairy than tomato production is less risky than allocating more to tomato production. This agrees with farmers' observation on the fluctuations associated with tomato production. It also brings to light farmers' selection of dairy as the favoured enterprise in the area, though with lower income compared to tomato production. Further, most of the farmers indicated that maize was preferred as it also serves as fodder for livestock hence supporting the dairy industry. presents the risk efficient production frontier and indicates that higher income can be achieved by increasing the area under tomato and decreasing that under dairy.

Table 2–Existing and optimal farm plans with minimised risk for Class 2 (Average farm area = 0.76ha)

	Existing Plan	Risk minimized plans					Optimal farm plan
	I	II	III	IV	V	VI	VII
Expected Shortfall (λ)		21,900	22,000	23,000	24,000	25,000	26,000
Net Return	35,656	76,544	76,608	77,256	77,904	78,552	79,036
Minimized SD	10694	17315	17550	20101	22929	25942	28283
CV[2] of net return (%)	29.99	22.62	22.91	26.02	29.43	33.03	35.79
Maize	0.125 (16)	-	-	-	-	-	-
Maize/Beans	0.25 (33)	-	-	-	-	-	-
Banana	0.025 (3)	-	-	-	-	-	-
Potatoes	0.11 (15)	-	-	-	-	-	-
Tomato	0.075 (10)	0.18 (24)	0.194 (26)	0.336 (44)	0.478 (63)	0.62 (82)	0.726 (96)
Dairy/Napier	0.175 (23)	0.58 (76)	0.566 (74)	0.424 (56)	0.282 (37)	0.14 (18)	0.034 (4)
Total cropped area	0.760	0.760	0.760	0.760	0.760	0.760	0.760
Labour used (MD)	37	74	75	83	91	100	106
Capital used (KES)	14381	26332	26859	32124	37389	42654	46595

NB: Figures in brackets represent percent of crop area to total cultivated area

Source: Field Survey 2004

[1] Adult equivalent as defined in Vlaming *et al*, (2000) defines ages 0 – 9 years as 0.25, 10 – 15 years as 0.8, 16 – 49 as 1 and above 49 as 0.7 adult equivalents.

[2] Coefficient of variation (%) = (standard deviation / net return) * 100%

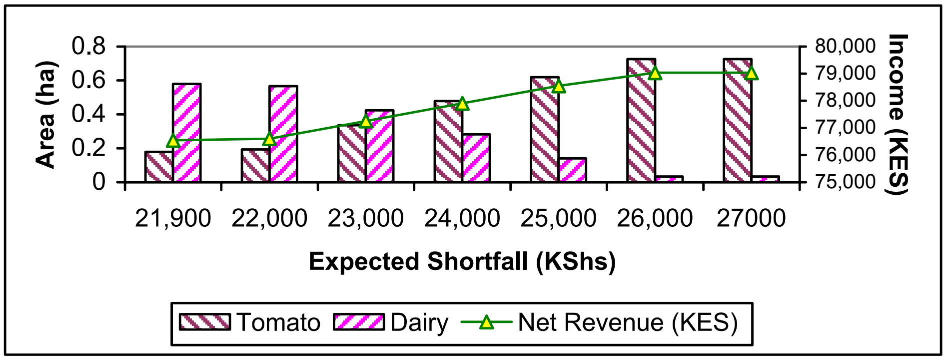

Fig.1: Risk efficient production frontier and enterprise mix for Class 2

Conclusions

From the plans, it is evident that dairy enterprise is still important in Githunguri division as indicated by previous authors. This implies that any soil fertility management technologies to be disseminated in the area need to take into considerations this enterprise. In case of use of leguminous crops for soil fertility, it is highly probable that the farmers will prefer to feed the crops to the livestock and use the manure for soil fertility management. Further, the study proved right the safety-first criterion advanced by many authors that risk-averse small-scale farmers' choice of enterprise mix and production levels is usually based more on subsistence than income.

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