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INDIGENOUS FARMERS MANAGEMENT OF LAND DEGRADATION: THE CASE OF ASUNAFO, GHANA

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ABSTRACT

The paper discusses farmers' strategies for managing land degradation. Land user perception on effectiveness of 25 land degradation management strategies were examined as involving slightly effective (e.g. use of household refuse), moderately effectively (e.g. crop diversification), largely effectively (e.g. watering of crops) and very largely effectively (e.g. hand weeding 5 or 6 times). The strategies were further subjected to strengths, weaknesses, opportunities and threats (SWOT), trend and cost-benefits analyses. About 71% of the management strategies showed higher benefits than cost (economically feasible) and 29% recorded higher cost than benefits. In the global quest to control land degradation, indigenous farmer knowledge, experience and experiments provide solid background.

1. INTRODUCTION

About 21.11% (50,365 km^2) of the land on which many Ghanaians depend for their livelihoods and immediate satisfaction of some basic human needs tends to be suffering from land degradation (Bai et al., 2008:229). Land degradation may be defined as the long-term loss of ecosystem function and productivity caused by disturbances from which land cannot recover unaided (Bai et al., 2008:223). It is manifested through progressive loss of land productivity, decline in land output potential, reduction in land resources and changes in land surface conditions unfavourable to crop production (Lui et al., 2003). Some associate land degradation with population increase and human mismanagement of land (Grepperud, 1996). Leach and Mearns (1996) consider the usage of population pressure hypothesis in land degradation analysis as misleading and lacking scientific verification. Hence, the alternative to land degradation, that

is, land improvement is equally possible to occur under population increase (Tiffen et al., 1994). In the case of Asunafo human population has increased from 48,043 in 1960 to 174,026 in 2000 contributing to conversion of large tracts of forest to cropland and other opportunistic land covers commonly associated with land degradation (Peprah et al., 2014). To this end, the current paper discusses management of land degradation by indigenous farmers of the Asunafo forest area of Ghana.

Management of land degradation briefly refers to balanced relationship between land cover and land use practices (Chakrabarti, 2004). Others consider it to be sustainable land management (Matari, 2007, Stocking, 2005).

At the global level, management of land degradation includes adoption of technology that brings new lease of life such as water pumping to mechanize boreholes or through the construction of hydro-technical installations such as dams, reservoirs, canals, collectors, and artificial drainage networks or monoculture and agroforestry in the case of drylands (Geist and Lambin, 2004). In specific instances, there are large-scale afforestation and grass planting as vegetation cover and land reclamation in certain localities in China (Lui et al., 2003). In Senegal, Bunning and Ndiaye (2009) reveal the success of afforestation, reforestation and sand dune stabilization generating benefits such as reduction in wind speed and wind erosion, provision of fire wood and materials for mulching and composting. Styger et al. (2007) recommend optimizing nutrient recycling through residue and weed recycling, mulching, improved fallow and crop cover. Management strategies applied to degraded areas in Burkina Faso include plantations, composting, cross-contour permeable rock bunds, dam gullies, reforestation, contour bunding, trash line, grass barriers and pits (zai) have resulted in immediate and positive effect on crop yield and soil quality (Oyowe, 1998, Batterbury, 1998).

2. MATERIALS AND METHODS

Asunafo comprised of two administrative districts: Asunafo North Municipal and Asunafo South District. Together they occupy surface area of 2.187.5 km^2 and located within latitudes $6^o27'N$ and $7^o00'N$ and longitudes $2^o23'$and $2^o52'W$ (Abagale et al., 2003). In terms of climate, the study area falls under the wet-semi equatorial climate and the vegetation type is moist semi-deciduous forest (Dickson and Benneh, 1988). Data from Ghana Meteorological Agency (2010) indicates two rainfall peaks occurring in May and October with a pronounced dry

season occurring in November to February. The highest temperature of 34.3^{o}C occurs in March and lowest temperature of 17.2 ^{o}C in January. Relative humidity peaks in July and August (77%) and falls to the lowest in February (47%).

The study involved a total of 774 farmers drawn from 21 communities and a sample size of 264 based on n=N/1+N (e)^2 where n is the sample size, N is the population frame [774] and (e) is the level of precision [0.05]. Primary data was sourced through questionnaire administration, key informant interviews, farm visits and group discussions. Land degradation management strategies were discussed and listed during the group discussions. The strategies were then evaluated by farmers during the questionnaire administration through ranking, trend, cost-benefit and SWOT analyses (strengths, weaknesses, opportunities, threats).

3. RESULTS AND DISCUSSIONS

Figure 1 shows categorization of management strategies of land degradation into a farmer scale of preference. The scale ranges from the highest to lowest as very largely, largely, moderately or slightly effective. The most preferred management strategy was used by 61% of 264 farmers and the least by 28% with the mean of 37% and standard deviation of 7.5%. Majority of farmers prefer to eliminate weeds by hand weeding with cutlass. An alternative strategy to control weeds is the application of weedicide which some farmers believe aggravate the degradation problem. Hence, the preparedness to do hand weeding as many times as required even if it has to be five or six time before harvesting. The least preferred strategy slash with selective burning is done after the farm plot fails to be cleared with fire. It involves a tedious job of gathering the slashed debris which refused to be burnt at a spot and setting fire to it.

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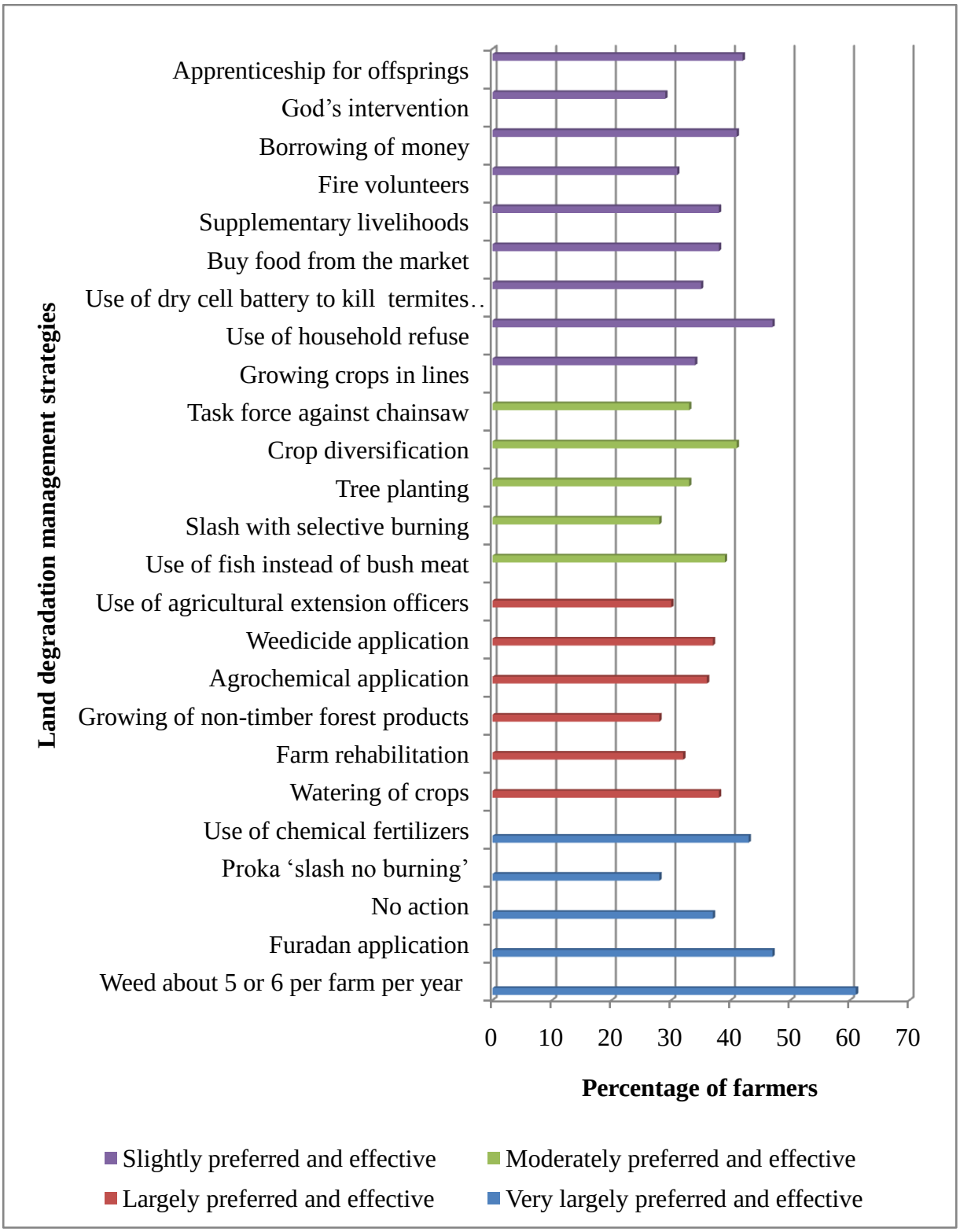

Figure 1: Farmers scale of preference for management strategies of land degradation

Source: Author

Figure 2 shows results of cost-benefit analysis. The cost-benefit analysis was performed for 21 strategies. Four strategies were not included in the cost-benefit analysis (use of household refuse fertilization, no adaptive strategy, apprenticeship of out-of-school going children and God's intervention). The results indicates that 71% (15) of the strategies were economically viable (B – C = positive value) while 29% (6) were not cost effective (B – C = negative value). The application of chemical fertilizer stood out clearly as economically very feasible (GH¢102.00). The most expensive strategy was purchase of supplementary food from the local market (GH¢-43.00). The mean benefit stood at GH¢21.09 with the standard deviation of GH¢36.48. Farmers maximize net benefit through the use of any strategy which displays positive outcomes. The top 5 economically viable strategies included use of chemical fertilizers (GH¢ 102.00), reliance on supplementary jobs (GH¢ 62.00), borrowing money (GH¢ 61.00), proka (GH¢ 53.00) and watering of crops (GH¢ 50.00). The strategies which showed greater cost than benefits included tree planting in farm (GH¢ -5.00), growing crops in lines (GH¢ -10.00), weeding 5/6 times a year in the same farm (GH¢ -23.00), use of fish instead of bush meat (GH¢ -30.00), farm rehabilitation (GH¢ -39.00) and buy food from the market (GH¢ -43.00). Therefore, any of the strategies which show negative returns make farmers worse off. Farmers would lose money if they use land degradation management strategies whose cost is greater than benefit. However, some farmers may choose to lose money in order to achieve non-economic objective. For instance, farmers may spend on perfumed rice because of taste.

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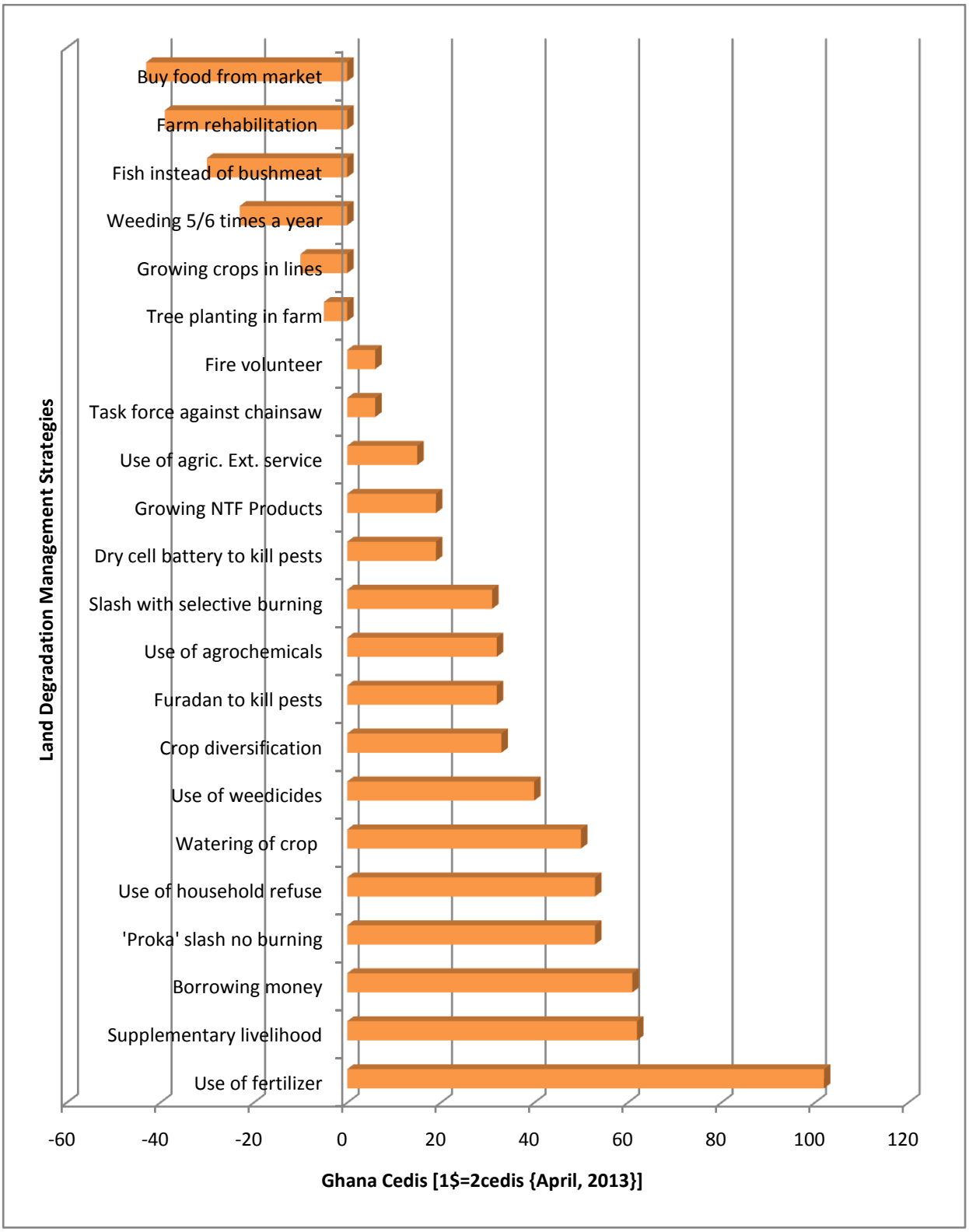

Figure 2: Results of cost-benefit analysis of land degradation management strategies

Source: Author

Table 1 indicates qualitative trend analysis over the past, present, preferred future and likely future. Land degradation was limited in the past. Therefore, many of the land degradation management strategies were not applicable. Application of weedicide, and agrochemicals as well as tree planting was not carried out. Chemical fertilizer application, borrowing of money and supplementary jobs were slightly used by farmers. Presently, the intensity of these strategies has increased greatly. Farmers wished they could reverse, halt or minimize land degradation. However, zero net land degradation is not practically achievable in the immediate future. Hence, the likely gain in importance of land degradation management strategies.

Table 1: Trend of management strategies of land degradation over four-time scales

Land degradation management strategies	**Past**	**Present**	**Desired future**	**Likely future**
Use of dry cell battery e.g. tiger head mixture with water to kill termites	• termites activities were limited and so use of battery was not common	• at least it is able to collapse termite hills	• that termite activities are reduced to no problem level	• termite activities would continue and battery would be used
Use of furadan to kill termites and *Camponotus*	• less common	• well known and widely used	• reduction in termite menace	• commonly used by many farmers
Use of weedicides	• weedicide was not known	• highly patronized • few skepticism	• preference for selective weedicides	• increases in usage
Hand weeding about 5 or 6 times a year	• weeding was done about 2 to 3 times a year	• weeding is done about 5 to 6 times a year	• reduction in number of times weeding is done	• increases over the present situation
Use of fertilizer	• slightly used	• much used	• increased application	• highly patronized
Use of agrochemicals	• not used	• averagely used	• improved application	• increased application
Tree planting in farm	• natural growth	• seedling nurseries • averagely planted	• natural growth	• more trees to be planted
Replace dominant crop e.g. cocoa with other crops	• less application	• highly practiced	• best use of land for most suitable crop	• increases in the practice

Proka slash and no burn	• commonly used	• slightly used	• increased application	• reduced application
Use of tanaa slash plus selective burning	• slightly used	• increased application	• avoid burning of whole farm	• increased application
No action	• normally the case	• do nothing about land degradation	• land becomes good	• persistence of land degradation and possible exacerbation
Growing crops in lines	• not carried out	• slightly used	• make good use of land	• widely accepted
Cutting old cocoa trees and replanting new seedlings/seeds (farm rehabilitation)	• occasionally done	• carried out but not extensive	• when it becomes necessary	• persistence and possible increase in the practice
Patronage of imported food	• modest patronage	• increased patronage	• reduced usage	• significant increase in usage
Watering of crops using water pumps	• less common	• considerably done	• rainfed	• highly patronized
Using of fish nsasaawa instead of bush meat wuramunam	• slightly used	• highly patronized	• less patronage	• increase in usage
Borrowing from local money lenders	• slightly done	• highly patronized	• lower interest rates	• increase in borrowing
Growing of non-timber forest product e.g. atotoo/dedaa/ginger	• free gifts from the forest	• slightly patronized	• extensive application	• sustainable increases
Fire volunteers	• informal	• not extensively used	• widespread	• sustainable increases
Task force against chainsaw operation	• did not exist	• highly patronized although dangerous	• empowered	• intensified
Use of agricultural extension service	• less patronage	• demand exceeds supply	• improvement in supply	• demand exceeds supply
Alternative livelihood e.g. small ruminants/ shoe repairing/ Kente weaving/ palm wine taping	• slightly used	• moderately patronized	• improvements	• sustainable increases
Use of household refuse	• not carried out	• only ash is used in vegetables planted to settlements	• not practicable	• not practicable

Source: Author

The SWOT of household refuse shows strengths as ability to improve land (4 farmers, 33%) and to serve as a source of manure (9 farmers, 67%); weaknesses as small amount of refuse generated by each household; opportunities as daily generation of refuse; and, threats as long distances between houses and farms.

Table 2 shows SWOT of dry cell battery as chemical application to eliminate termites from anthills. 'Tiger head' battery has the ability to kill termites and collapse termite hills. However, the batteries are expensive and their application to the land leads to death of other useful soil organisms particularly earthworms. Sometimes used batteries could be collected freely from elsewhere. The main threat is posed by the increasing rural electrification resulting in reduction on the reliance on torchlight and the use of dry cell batteries.

Table 2: SWOT analysis of the use of dry cell battery to manage termite hill

Use of Dry Cell battery			
Strength (S)	**Weakness (W)**	**Opportunities (O)**	**Threats (T)**
• kills termites (3 farmers, 25%) • increases crop yield (2 farmers, 16.7%) • restores soil fertility (8 farmers, 58.3%)	• it is expensive (7 farmers, 54%) • kills soil organisms e.g. earthworms (4 farmers, 31%) • dangerous to humans (2 farmers, 15%)	• used batteries come at no cost (13 farmers, 100%)	• low battery use due to electricity (8 farmers, 62%) • shortage of battery (2 farmers, 15%) • poisonous (3 farmers, 23%)

Source: Author

Figure 3 shows the result of the SWOT analysis of furadan. The strength of furadan lies in its ability to efficiently and quickly destroy termites and *Camponotus*. It also serves as insecticide and nematicide. However, some farmers are not able to buy furadan because of the high market price. Threats are indicated by high market prices of furadan and frequent shortage.

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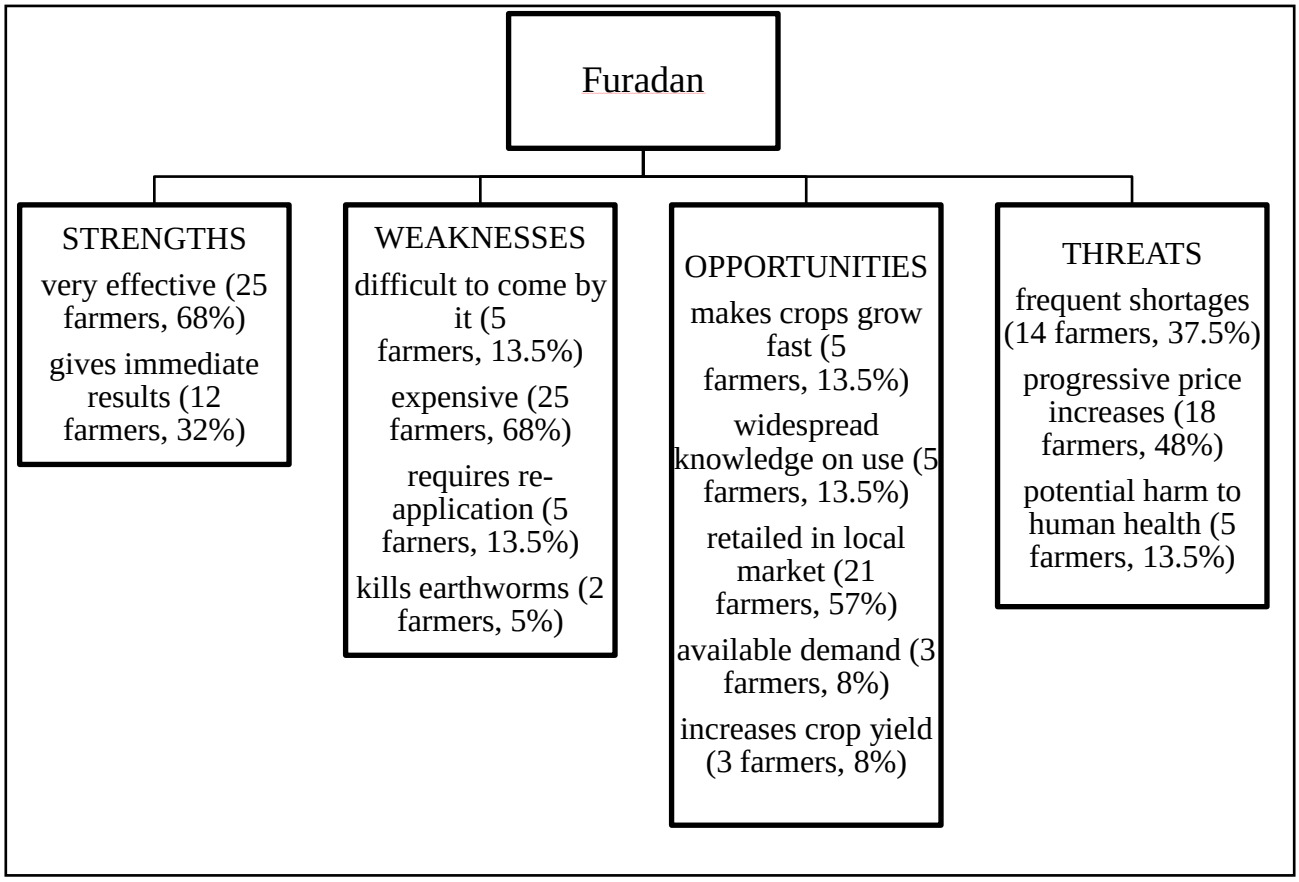

Figure 3: Results of the SWOT analysis of the application of furadan

Source: Author

During the dry season, vegetable farmers rely on the stream to water their crops. The strengths include improvement in dry season farming (11 farmers, 46%), makes crops grow fast (7 farmers, 29%), ensures that farmers are engaged in farming throughout the year (4 farmers, 17%), enhances food supply and farm income (2 farmers, 8%). The weaknesses involve drastic reduction in the volume of water in the rivers (10 farmers, 42%), expensive investment (8 farmers, 33%), tedious job with the tendency to damage the waist (4 farmers, 17%) and time demanding (2 farmers, 8%). Opportunities consist of a prolong dry season which creates a conducive environment for vegetable farming (18 farmers, 75%), water supplied by Rivers Tano and Bia (2 farmers, 8%) and availability of hired labour (4 farmers, 17%). The threats comprise of high cost of water pumping machines (18 farmers, 75%), low financial state of farmers – poverty (4 farmers, 17%) and weed competition with crops (2 farmers, 8%).

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Figure 4 shows SWOT analysis for weedicide application. The strengths include simple mode of application, requiring a bucket, water and a spraying machine or a sprinkler. Some farmers use brooms and do the sprinkling from ordinary bucket. Weaknesses involve the tendency to destroy crops once it comes into contact. There is easy accessibility to weedicide due to the large presence of agrochemical retailed shops in the districts. Rainfall renders it ineffective. Some farmers are, however, skeptical about the use of weedicide. They claim that the continuous application of weedicide leads to the hardening of land. Apparently, this assertion was not verified by this study.

Weedicide Application

STRENGHTS	WEAKNESSES
• takes little time to cover large area (6 farmers, 5.5%) • easy to use (33 farmers, 29.1%) • small quantity for large area (17 farmers, 14.5%) • effective and reliable (21 farmers, 18.2%) • less labour (14 farmers, 12.7%) • reduces weeding (23 farmers, 20%)	• destroys crops (66 farmers, 57.9%) • not affordable (30 farmers, 26.3%) • kills earthworms (18 farmers, 15.8%)
OPPORTUNITIES	**THREATS**
• traded in retail shops (95 farmers, 83.7%) • available labour for spraying (8 farmers, 7%) • spraying machine is manual, no fuel (11 farmers, 9.3%)	• progressive price increases (43 farmers, 37.5%) • distance to water source (28 farmers, 25%) • insufficient spraying machines (38 farmers, 33.3%) • rainfall immediately after application renders it ineffective (5 farmers, 4.2%)

Figure 4: SWOT analysis of use of weedicide

Source: Author

Figure 5 depicts results of the SWOT analysis on weeding in-between crops 5 or 6 times per farm per annum. In this case, crops do not compete with weeds. The slashed debris serves as mulch and later decomposes to become soil organic matter. However, it demands a lot of tiresome labour at a cost and comes with occasional cutlass injuries.

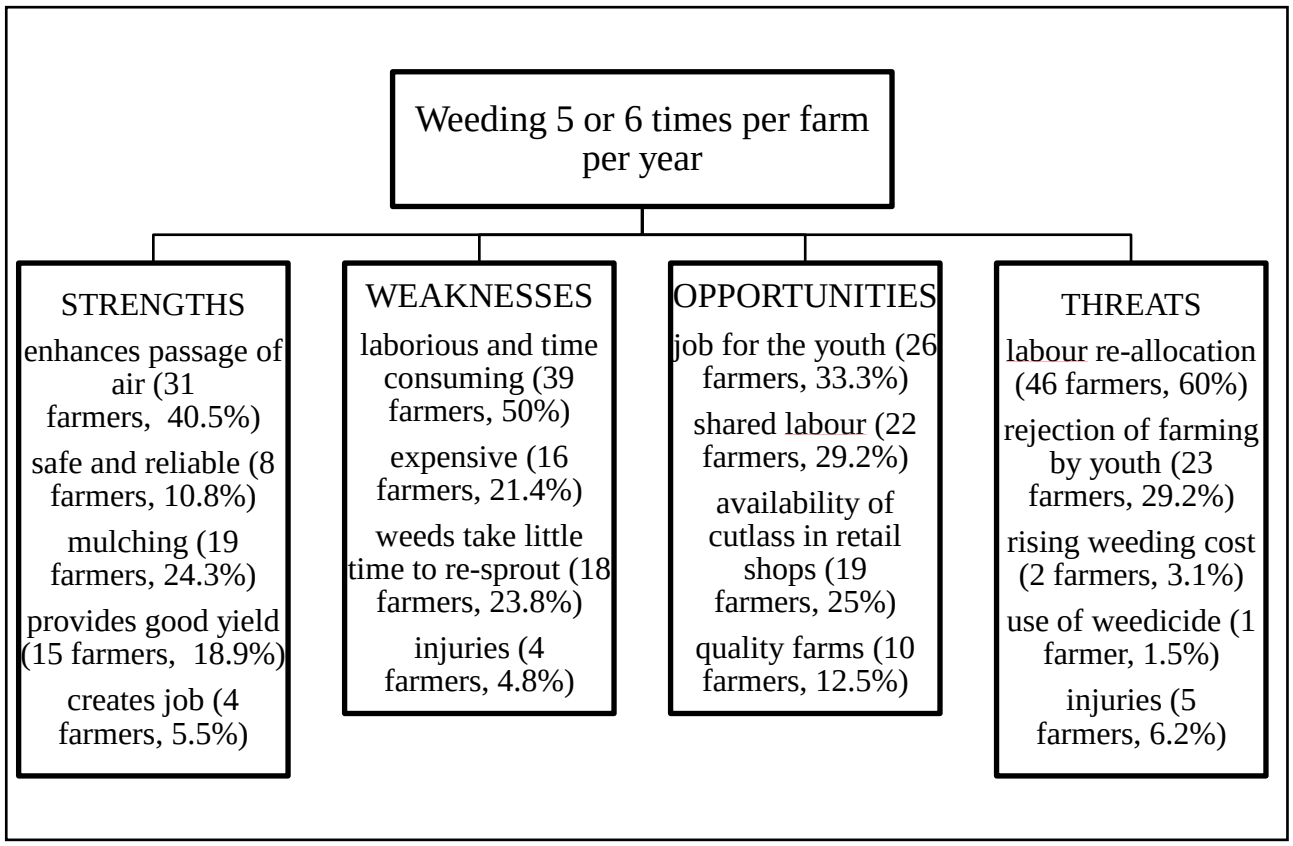

Figure 5: SWOT analysis of weeding 5 or 6 times per farm per year

Source: Author

Hand weeding creates jobs for hired labour particularly the youth as well as market for cutlass. The rapid increases in grass and other weeds pose a serious threat. The youth tend to look for jobs that bring quick and lots of money.

Figure 6 portrays SWOT analysis on the patronage of food from the market. The market is an alternative and reliable source of food supply (58 respondents, 66.7%) however, marketed food-stuffs and cooked food are unaffordable. Several varieties of food are available in the market. To the poor, accessibility to the food in the market is hugely limited.

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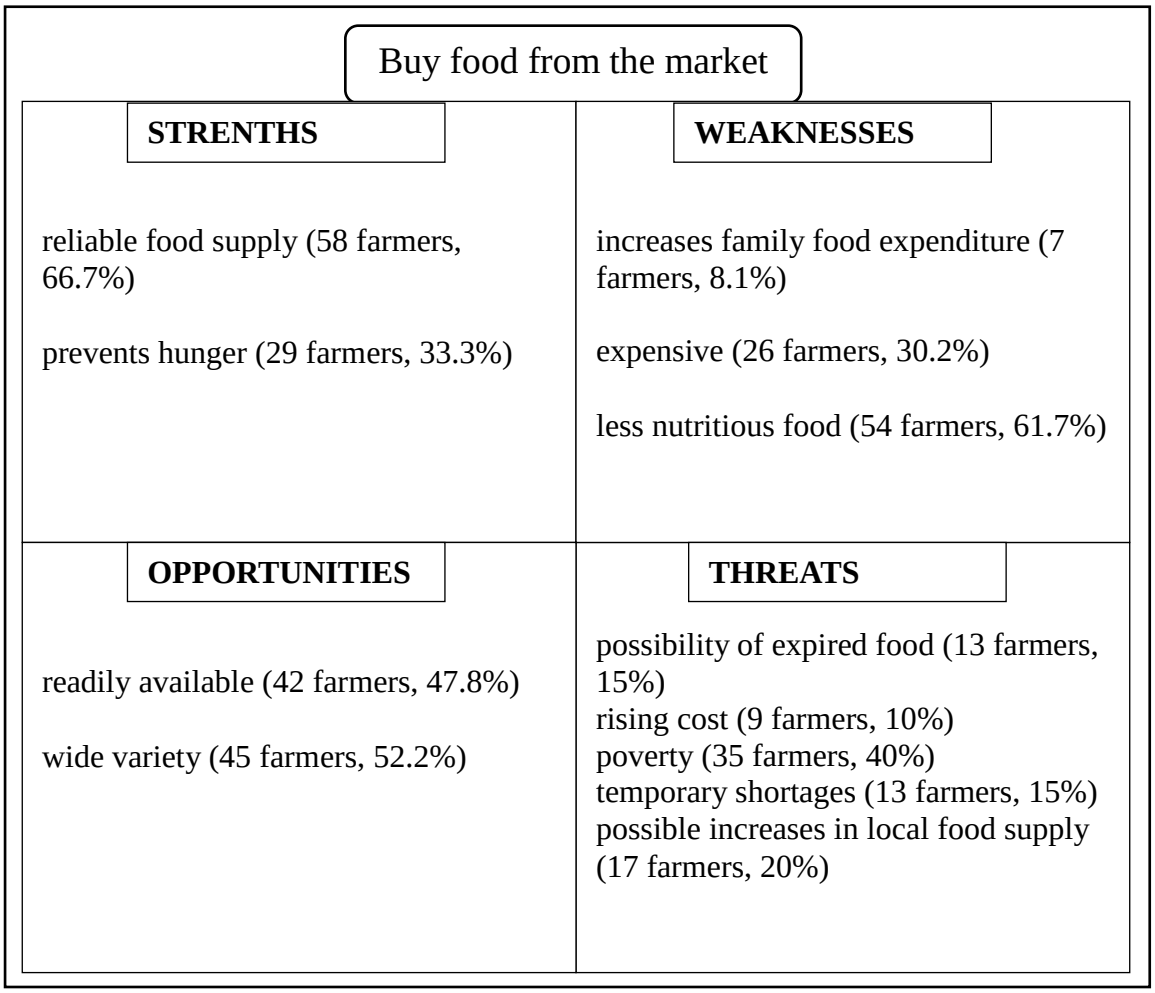

Figure 6: SWOT analysis of buying food from the market

Source: Author

The strengths of fire volunteerism include ability to control actual wildfires (5 farmers, 38.9%), the willingness of the volunteers (4 farmers, 33.3%), the power to deter people from irresponsible bush burning (2 farmers, 16.7%) and the protection of forest reserves from wildfire (1 farmer, 11.1%). The weaknesses involve non-existence of volunteers (7 farmers, 56.3%), shortage of water during fire-prone dry seasons (5 farmers, 37.5%) and levies imposed on burning of slashed fields (1 farmer, 6.2%). The opportunities consist of social recognition and supplementary income (6 farmers, 45.5%), the presence of huge financial investment to protect particularly the cocoa farms (4 farmers, 27.3%), duties occupy the volunteers during the dry season (2 farmers, 18.2%) and the volunteers get the chance to receive fire education (1 farmer,

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9.1%). Threats comprise of increase in incidences of bush fires (7 farmers, 56.3%), low incentives for volunteers (4 farmers, 31.3%), delay in responding to farmers' request (6.3%) and aged and weak volunteers (6.3%).

The strengths of the growing non-timber forest products include the generation of supplementary income (12 farmers, 50%) and provision of land cover (8 farmers, 33.3%). It also serves as a watchdog against bushfire (4 farmers, 16.7%). The major weakness is that the NGO – (Agri-Business in Sustainable Natural African Plant Project (ASNAPP) – in collaboration with Inter-Church Organization for Development Cooperation (ICCO)) is the only supplier of seeds and seedlings as well as buyer of the products. Readily available seeds and seedlings is an opportunity. Threat involves the cost of growing materials.

Figure 7 shows SWOT analysis on loans (borrowing of money). About 76% of the farmers rely on loans. The strengths consist of relief from financial stress (142 farmers, 70.4%). A fundamental weakness is failure to redeem loans or perpetual debtors (50% of 201 farmers). An important opportunity is the proliferation of micro credit schemes in the districts which always make loans available to prospective cash trapped farmers (50% of 201 farmers). However, about 161 farmers (80% of 201) consider the high interest rate as the biggest threat.

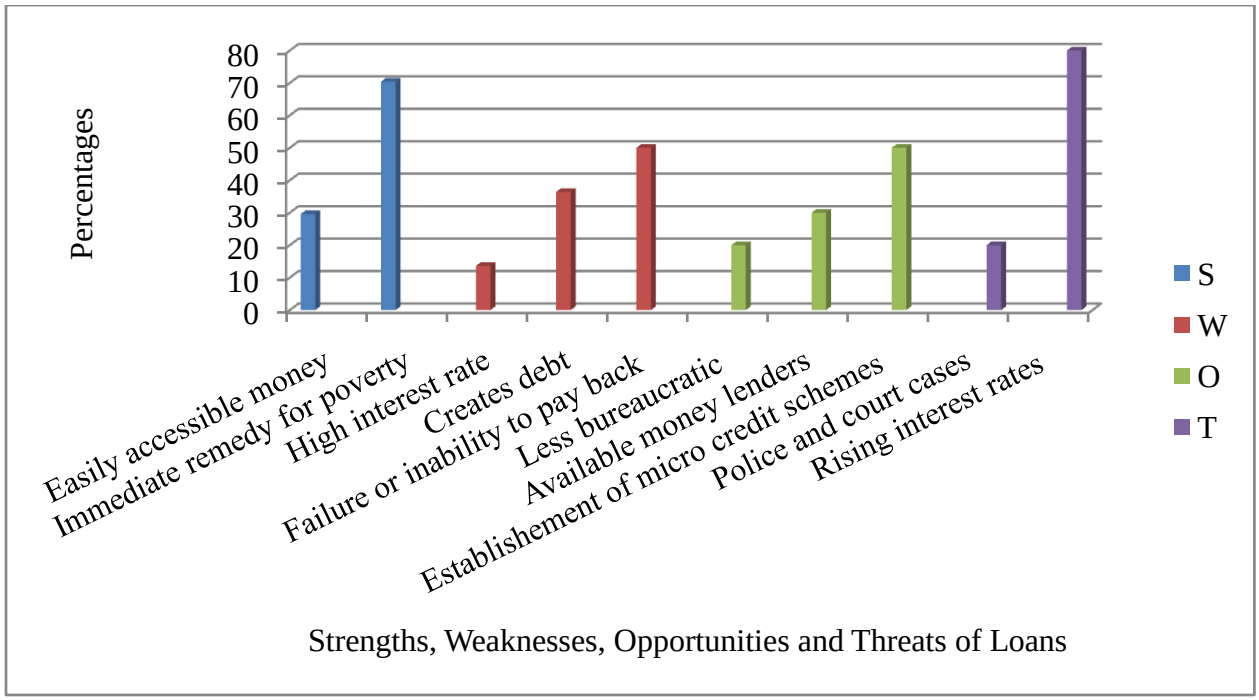

Figure 7: SWOT analysis of borrowing of money

Source: Author

The strengths of additional jobs are the provision of extra income (38 farmers, 76.5%) and food (3 farmers, 5.9%). Supplementary jobs bring prestige (9 farmers, 17.6%). Weaknesses include fatigue (16 farmers, 31.3%), debt – running at a loss (28 farmers, 56.3%) and adversely affects time left for farm work and leisure (3 farmers, 6.3% each). Opportunities involve provision of manufactured goods (25 farmers, 50%), income and food from small ruminant raising (4 farmers, 8.3%); skills training for apprentices (13 farmers, 25%) and market for goods and services (8 farmers, 16.7%). However, supplementary livelihoods face a number of threats such as laborious nature of some of the jobs and their health implication (21 farmers, 42.9%), raising of startup capital (14 farmers, 28.6%), inadequate skills (7 farmers, 14.3%) and the risks involved in trekking (7 farmers, 14.3%).

The SWOT analysis indicates that the strengths of using fish instead of bush meat are the conservation of wildlife (13 respondents, 25.6%), provision of supplementary food (22 respondents, 44.2%) at low cost (7 respondents, 14%) and provision of additional livelihood for female farmers (8 respondents, 16.3%). The weaknesses include the stress on aquatic life (4 respondents, 8.8%); increases family food expenditure (41 respondents, 82.4%) and the lack of substitute for fish (4 respondents, 8.8%). The opportunities that ensures continuous usage of fish as a coping strategy are readily available demand (17 respondents, 34.8%), available supply of fish (20 respondents, 39.1%) and the willingness of women to sell fish (7 respondents each, 13%) as well as establishment of cold stores (7 respondents each, 13%). However, this strategy is threatened by the rising cost of fish (23 respondents, 45%), poverty (8 respondents, 15%), occasional shortages (18 respondents, 35%) and storage problems (3 respondents, 5%).

Figure 8 shows that the main strengths of proka include the ability to improve the soil and reduce bush fires at the same time. However, the principal weakness is that the debris makes planting of crops and weeding extra difficult. The strongest opportunity is that forest vegetation provides a lot of litter which decomposes and adds to soil organic matter.

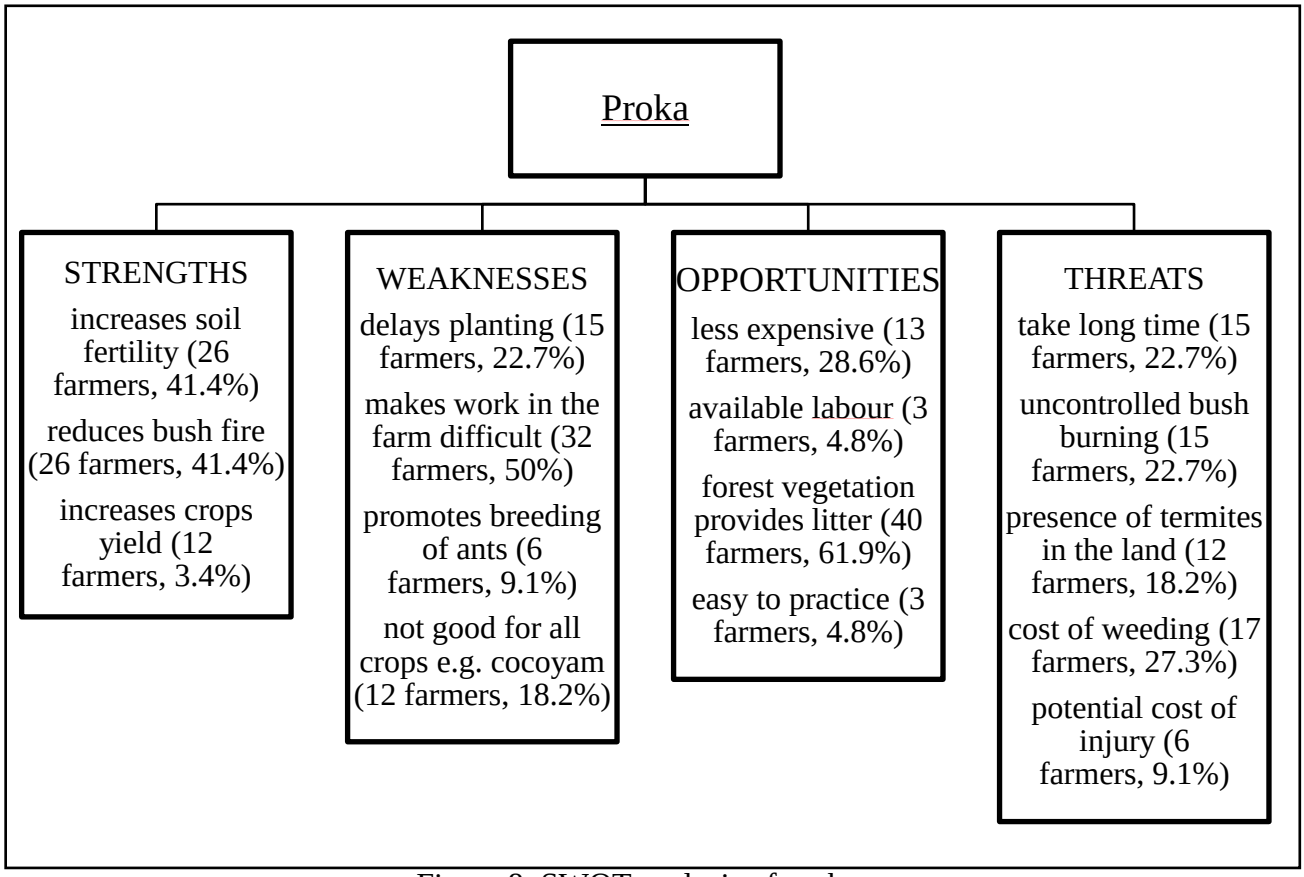

Figure 8: SWOT analysis of proka

Source: Author

The respondents categorized strengths of slash with selective burning into the following: reduces bush fires (1 farmer, 8%), makes work in the farm easier (2 farmer, 15%), makes crops grow faster (3 farmers, 23%) and improves the land (7 farmers, 54%). However, slashing and gathering debris at specific spot before burning is laborious (6 farmers, 46%), crops grown at burnt spot gives low yield (3 farmers, 23%) and it is expensive due to the hired labour involved (4 farmers, 31%). The opportunities which sustain this strategy include the availability of shared and hired labour (3 farmers, 23%), the presence of fire volunteers (6 farmers, 46%) and the use simple tools (4 farmers, 31%). The strategy is threatened by the high potential to get injured (5 farmers, 38%), the rising cost of hired labour (4 farmers, 31%) and the increasing use of weedicide (4 farmers, 31%).

Figure 9 shows SWOT analysis of chemical fertilizer application. Strengths include bumper harvest (84 farmers, 73.8%). It is perceived to be expensive (89 farmers, 78.7%).

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Chemical fertilizers are available at the District Agriculture offices as well as retailed shops; however, usage may be hampered by increasing prices and occasional shortages.

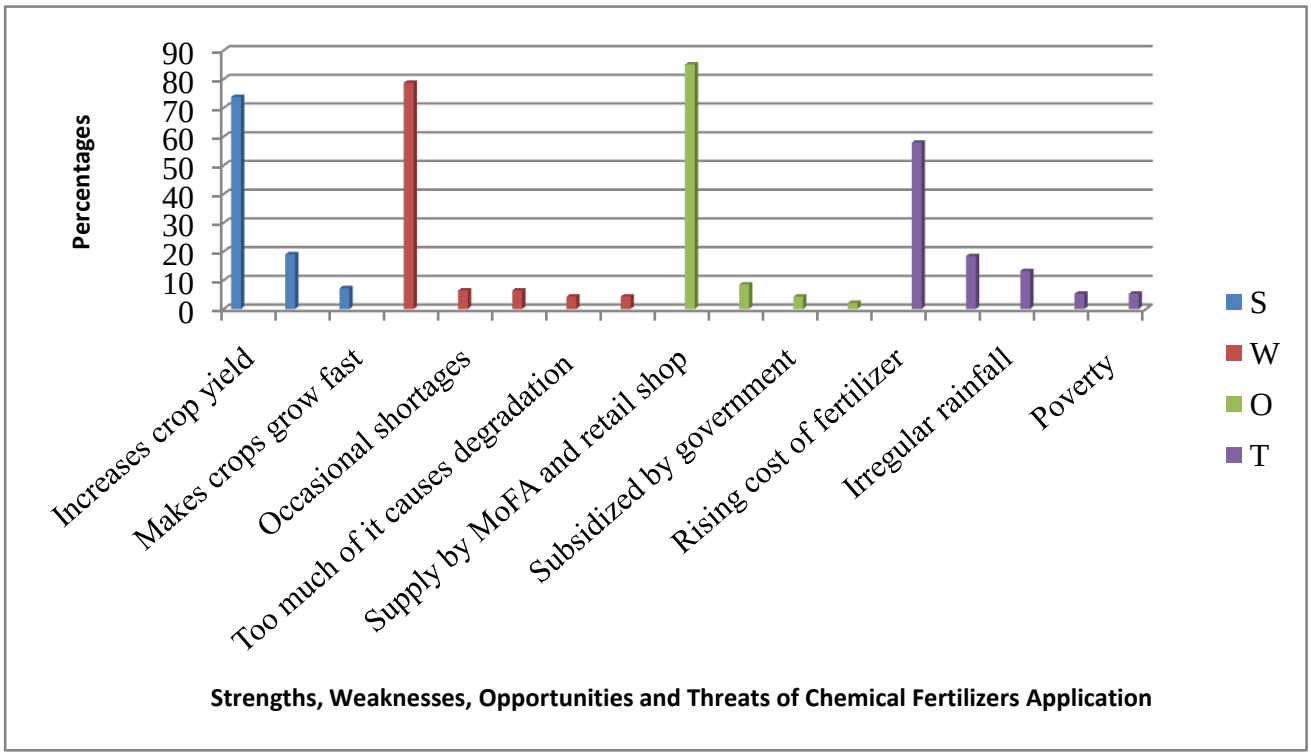

Figure 9: SWOT analysis of fertilizer application

Source: Author

The strengths of farm rehabilitation (replacing over 70 years old cocoa trees with seedlings) include the ability to increase crop yield (4 farmers, 31%), integrate crops with trees (4 farmers, 31%) and replace less productive crops (3 farmers, 23%). It also leads to the rebirth of farms (2 farmers, 15%). The weaknesses involve laborious activity (1 farmer, 8%), time consuming (7 farmers, 54%); high farm expenditure (3 farmers, 23%) and creates poverty as new plants take about three or four years to develop and bear fruits (2 farmers, 15%). Opportunities include availability of simple farm tools (4 farmers, 30%), agrochemicals (7 farmers, 54%), many old cocoa farms requiring re-birth (1 farmer, 8%) and technical support from agricultural extension service (1 farmer, 8%). The threats of farm rehabilitation are aging farmers (2 farmers, 16%), bush fire (3 farmers, 26%), huge monetary cost (6 farmers, 47%) and weed control (1 farmer, 11%).

The strengths of growing crops in lines include efficient use of land (6 farmers, 46%), increases crop yield (2 farmers, 15%), makes crops grow faster (4 farmers, 31%) and ensures easy clearance of weeds (1 farmer, 8%). Some weaknesses involve the laborious nature of the tasks (7 farmers, 54%), the low level of technical expertise of local farmers (2 farmers, 15%) and exacerbate spread of diseases (4 farmers, 31%). Opportunities consist of availability of hired labour (7 farmers, 54%), agricultural extension services at District Agriculture office (4 farmers, 31%) and simple tools (2 farmers, 15%). Threats comprise of scarcity of agricultural extension officers at the farming communities (8 farmers, 62%) and time consuming (5 farmers, 38%).

Agricultural extension service as a strategy possesses a number of strengths: it educates farmers (10 farmers, 38%), provides supports services (9 farmers, 35%) and improves crop yield (7 farmers, 27%). The weaknesses include scarcity and irregular supply of officers (4 farmers, 15%), methods are difficult to follow (12 farmers, 46%), expensive (2 farmers, 8%), distance between officer-location and farms (5 farmer, 19%) and officer-response rate (3 farmers, 12%). The opportunities consist of radio education by agricultural extension officers (3 farmers, 12%), local communities expectation for posting of officers (50%), availability of information centers in the communities (4 farmers, 15%), organized meetings (3 farmers, 12%) and farmer association (3 farmers, 12%). Threats comprise of bureaucratic procedure (10 farmers, 38%), low incentives to extension officers (3 farmers, 12%), cost of feeding and transporting extension officers (3 farmers, 12%) and expensive cocoa spraying machines and agrochemicals (10 farmers, 38%).

The use of taskforce against chainsaw operation has the potential to reduce deforestation (5 farmers, 38.5%), has made farmers vigilant (5 farmers, 38.5%) and the community as watchdog (3 farmers, 23%). It is, however, saddled with the fear for farmers to join the taskforce (8 farmers, 62%), difficulties in meeting with chainsaw operators (4 farmers, 31%) and low incentives for members of the taskforce (1 farmer, 7%). There is the possibility that the district assemblies (5 farmers, 38.4%), police (4 farmers, 31%), traditional authorities (2 farmers, 15.3%) and forestry commission (2 farmers, 15.3%) may cooperate with the taskforce to decrease the activities of chainsaw operators. However, the low incentives of the members of taskforce (2 farmers, 15.3%), attacks on the life of taskforce members by chainsaw operators (2 farmers, 15.3%), presence of many sawmills in the districts (2 farmers, 15.3%) as well as high

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demand for wood products (7 farmers, 54.1%) threaten the continuous operation of the taskforce against chainsaw operation.

After planting, trees grow and develop to provide shade for cocoa and plantain (11%), the leaves that drop to the land decompose to add organic matter to the soil (78%) thereby contributing to the maintenance of soil fertility while lots of the trees help create conducive micro-climate for the general agricultural activities (11%). However, tree planting is an arduous task demanding plant nursery, transportation of seedlings to the farm, actual planting, tending and beating up until the tree are left on their own (70%). During rain storms, branches of trees or sometimes the whole tree falls to destroy crops (20%). Seedlings for planting are sometimes free of charge or are offered on credit to be paid at a later date. The threats include extraction of timber. Figure 10 shows SWOT of tree planting.

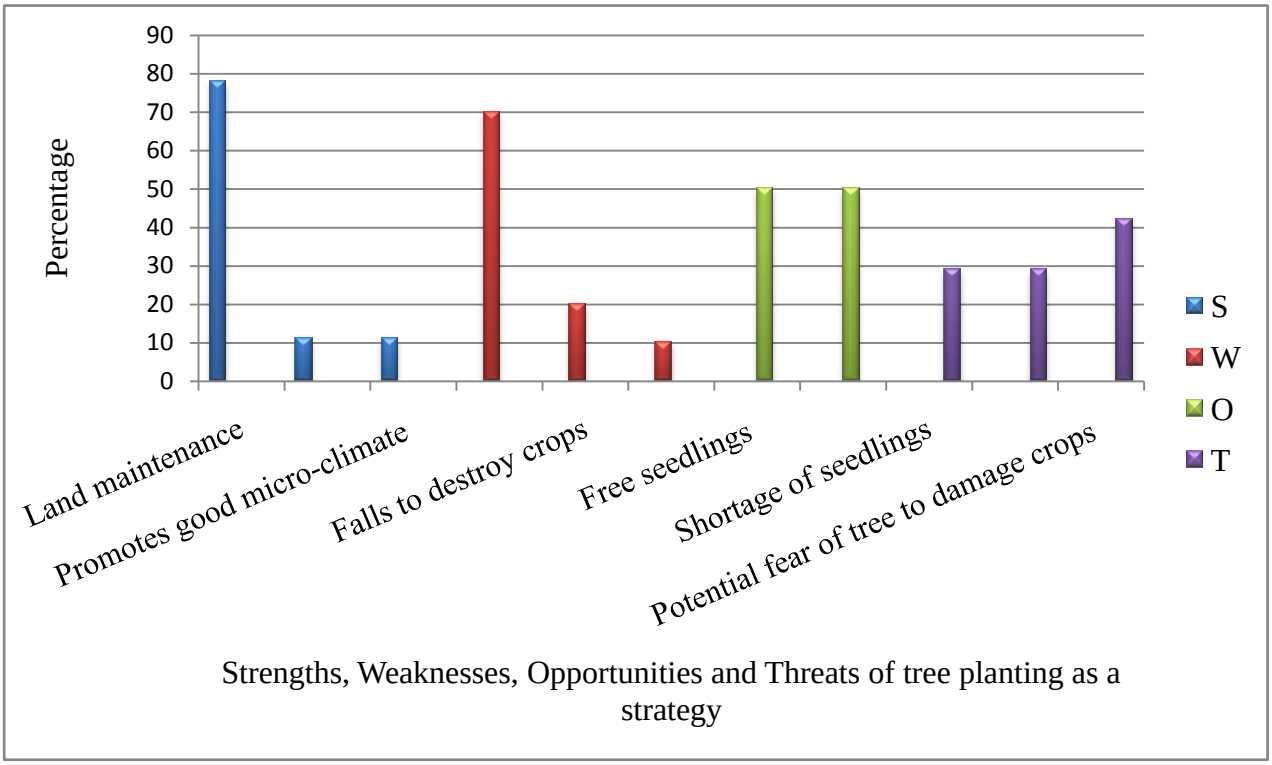

Figure 10: SWOT analysis of tree planting

Source: Author

The largest strength of crop substitution lies in the ability to increase crop yield. About 18 farmers (70%) perceive it to be laborious (weakness) and 12 farmers (45.5%) consider the

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availability of hired labour and use of simple farm tools as opportunity. Some 19 farmers (72.2%) see the recent increases in the producer price of cocoa as a threat. Already, some oil palm farms are being hue down to grow cocoa. In the past, such areas did not support cocoa but now young farmers are giving it a try. Figure 11 shows SWOT analysis of crop substitution.

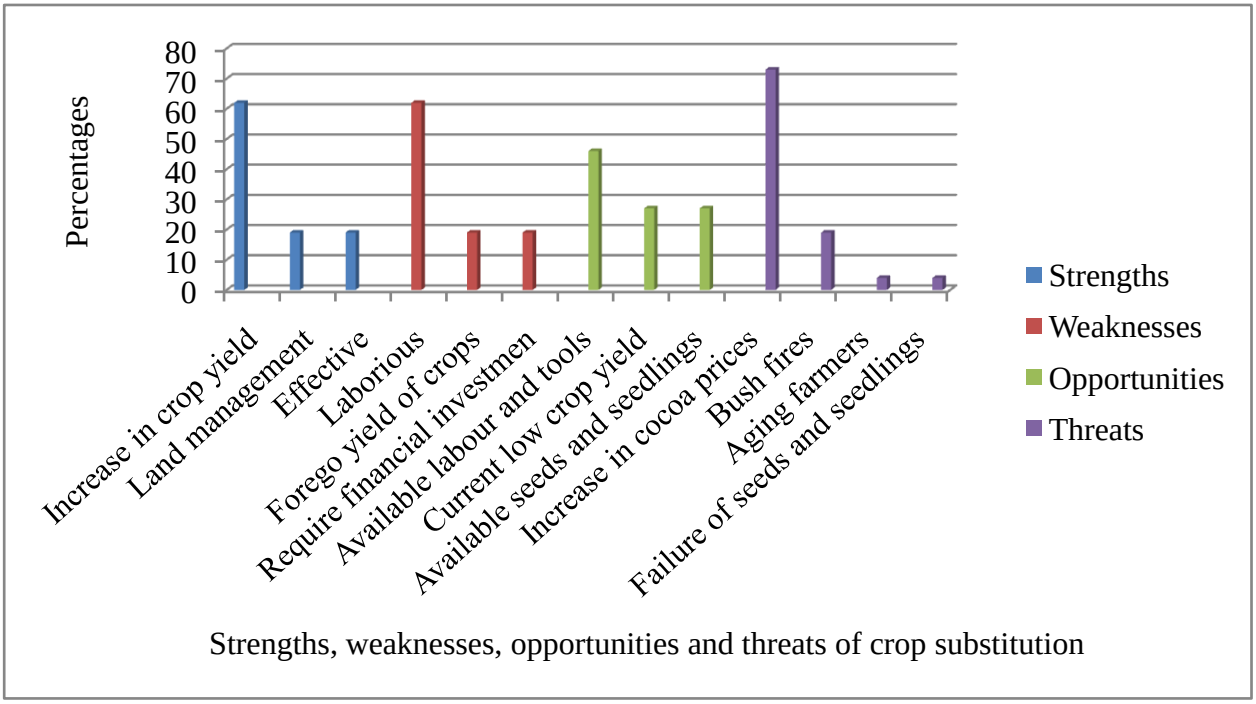

Figure 11: SWOT analysis of crop substitution

Source: Author

Agrochemicals (insecticides) found in the local market have brand names such as Lamda Master, Bossmate, Sumitox, Kombat, Sumico 200 EC, Consider, Sumitex 400 EC and Sunpyrifox 48% EC. Fungicides include Limaned Diathane and Kilazeb 80 WP. The results of SWOT analysis show the ability of agrochemicals to provide quick and effective control of pest and diseases (71 farmers, 51.9%) as a major strength. About 96 farmers (70.6%) perceive harm caused by improper application as the main weakness. Some 84 farmers (61.5%) have observed ready availability in retailed shops and the District Agriculture office as a key opportunity and 92 farmers (66.7%) claim that the high prices of agrochemicals is a principal threat. Figure 12 shows SWOT analysis of agrochemical application.

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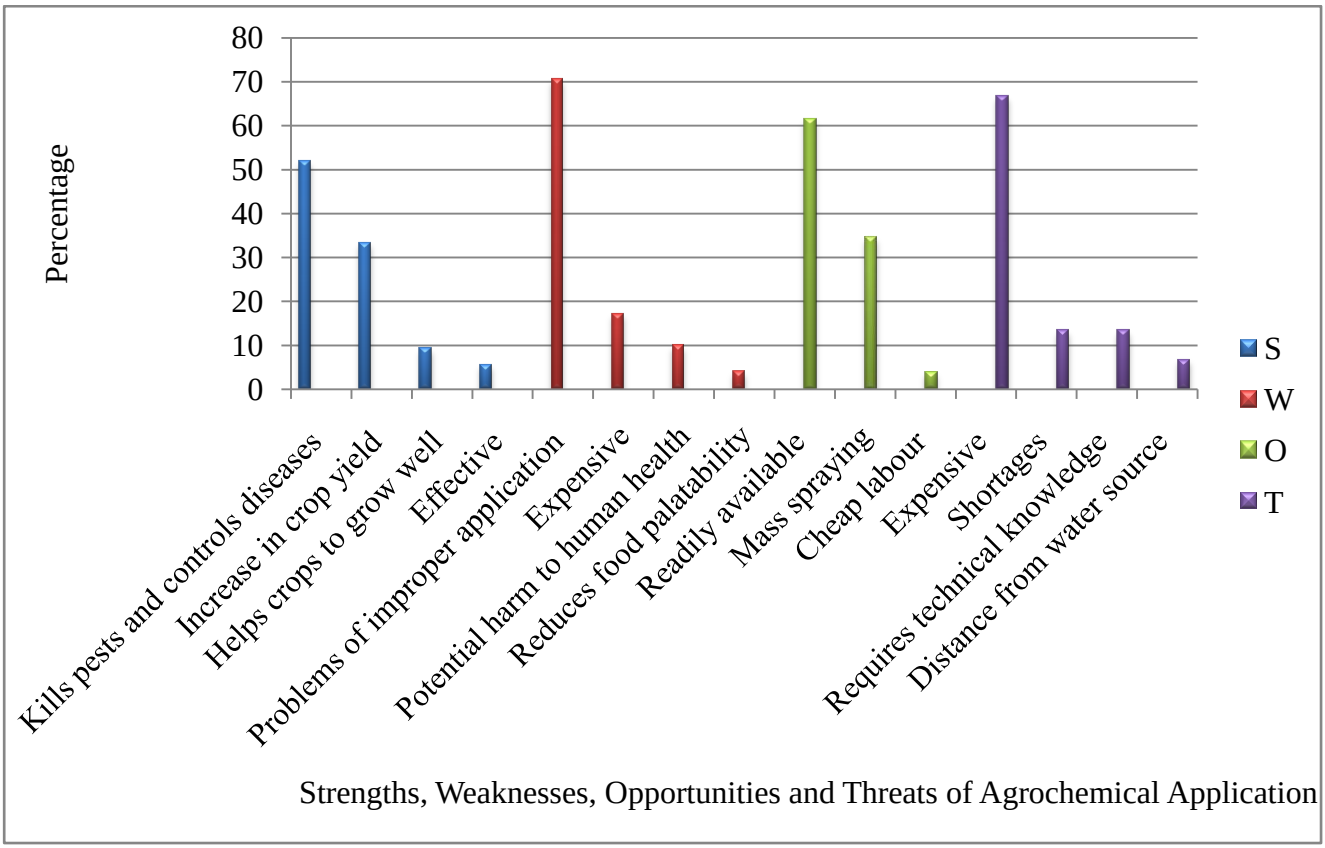

Figure 12: SWOT analysis of agrochemical application

Source: Author

Indigenous farmers possess particular strength in dealing with the menace of land degradation in the forest environment as shown by identification and usage of 25 farmer management strategies. The strategies can be grouped into two: short-term and long-term outcomes. For instance, the application of chemical fertilizer only satisfies the nutrient requirement of the crops. After the crops have used up the additional nutrient supplied by the chemical fertilizer the land returns to its degraded state. The use of agricultural extension officers offer farmers current techniques such as farm rehabilitation, growing of crops in lines, application of agrochemicals, crops substitution and tree planting. These strategies take many years for expected outcomes to emerge.

The economically beneficial strategies particularly the use of chemical fertilizers were highly patronized because it brought about high yield in cocoa. Dry cocoa beans enjoyed centralized market and Ghana Cocoa Board pricing. Therefore, farmers were able to reap the returns to chemical fertilization of their cocoa farm. Food crop farms did not enjoy chemical

fertilizer inputs. Also, commercial vegetable farmers who depended on small-scale self-operated irrigation also benefited from the application of chemical fertilizers. Therefore, when the crop has ready market and brings quick cash/income returns to farmers, chemical fertilizer is applied to boost yield in degraded lands. The strategies which showed higher cost and benefits particularly tree planting and farm rehabilitation have long gestation period for expected output to emerge. In such situations farmers would have to forgo their income and wait for the trees to mature. With regard to weed control, hand weeding with cutlass and hired labour generated higher cost than benefits. Instead of hand weeding three times in the year, farmers have to do so five-six times a year due to land degradation. Previously, the forest provided game, wildlife and food. Land degradation has hampered these productions and so farmers made do with dry fish and imported rice from the market at a higher cost than benefits. The trend analysis found proka and household refuse fertilization to be unsustainable. The rest of the adaptive strategies were considered to be sustainable. It is implied that land degradation would persist and so do the remaining 23 management strategies.

4. CONCLUSION

Farmer activities at remedying land degradation have been exhibited in the way they use 25 strategies to manage the degradation. Some of the strategies are economically beneficial to farmers particularly the application of chemical fertilizer. However, some strategies were found to be cost ineffective but farmers use them due to non-economic reasons. In the global quest to control land degradation, indigenous farmer knowledge, experience and experiments provide solid background.

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