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Targeting the Challenges of Agro-forestry System Disappearance under Rapid Commercialization: Factor Affecting Farmers Land Use Options in Gum-Belt of Western Sudan

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Abstract
This paper intended to assess the impact of commercialization on the farm household resources allocation decision in the gum belt and to analyze the determinants of gum agro-forestry system practice in dry–land agriculture in western Sudan. Results from commercialization index (AC1) and the Two-Stage Least Square model (2SLS), confirm a positive significant influence of commercialization as well as the investment in livestock on production of food crops. Furthermore, results from the probit model revealed that, commercialization decision related with decreasing probability of the gum agro-forestry system practice decision, while effectively attractive price level equivalent to off-farm income is required if the sustainable gum Arabic production system is to be conserved. Finally, household decisions to allocate more resources to cash crops, access to market and investment in livestock to ameliorate the risk appears to justify these resources allocation under degraded agricultural production environment.

Keywords: 2SLS, Acacia, Commercialization Index, Dry-land, Gum, Sudan.

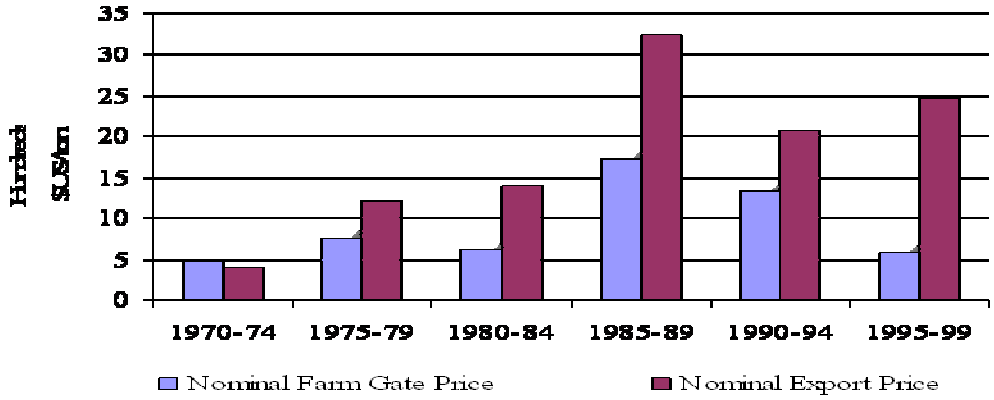
1 Introduction
Agro-forestry farming management strategy has played a prominent role in many development projects in the African Sahel, yet indigenous systems, such as the Sudanese gum agro-forestry system, has often been overlooked, despite their success. Gum Arabic is an important non-wood forest product (NWFP) obtained from Acacia senegal tree. Sudan accounts for nearly 80% of the world production and controls 60% of gum Arabic world market (El-Khidir 2003). Gum Arabic is also a significant source of cash income for the peasant communities occupying the gum belt, it accounts for 15% of the gum Arabic producers' income and 10 % of other farmers (Taha 2000). However, the production has slumped over the last decades beside that the gum agro-forestry system is now facing the challenge of the acacia's land conversion into commercial field cropping enterprises, with even more adverse impact on the smallholders' welfare and intimidates the system sustainability.

The overall objective of agricultural policies that concerned by the strategic plans along the period 1960/61 up-to-date is promoting production and transforming the smallholder from being subsistence into commercial agriculture farmers through cash crops expansion. This favoritism is manifested in credit allocation, providing of improved seeds and adopting marketing rather than production-led strategy. Information on the impact of commercialization on sustainability of the gum agro-forestry system in the Sudan is greatly lacking. Therefore, this paper intended to assess

the impact of commercialization on the farm household resources allocation decision and to analyze the determinants of gum agro-forestry system practice in the gum belt in dry–land agriculture in western Sudan, in addition to discuss the policy implications for improving the contribution of commercialization to rural economy at the continuation of the gum agro-forestry system. Finally, the paper is organized as follows: in section two, we present study methodology; as well data and variables selection were highlighted; the results were presented and discussed in section three and finally, in section four, summary and conclusions were drawn.

1.2 Commercialization and Gum Agro-forestry System

It is common in the gum belt that gum Arabic production is integrated into agricultural cropping through a system called the ‘‘gum cultivation cycle’’ or the ‘‘bush-fallow system’’. Under this system farmers would cultivate the land during 4-8 years (in the West) and 5-10 years (in the East) with millet, sorghum as the staple food crops, sesame, groundnuts, watermelon seeds or hibiscus Roselle (*Karkadee*) as the most important cash crops. When the soil is exhausted the farmer relocates another plot which he has left fallow. In the abandoned plot acacias will start growing and decolonizing the plot and substitutes for soil fertility by increasing additives.

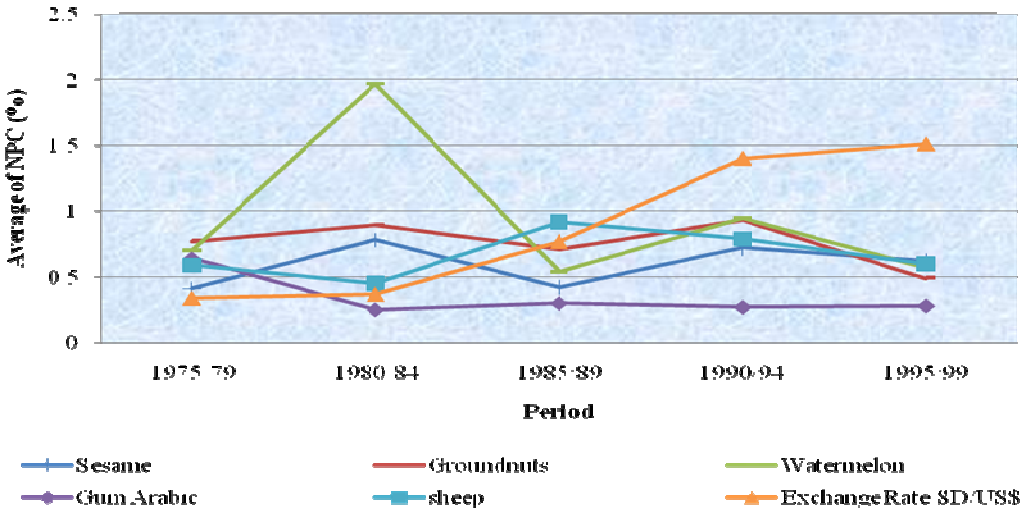


Source: Own calculated from GAC report (2000)

Figure 1.1: **Gum Arabic periodical farm gate & export nominal prices (1970 - 1999)**

The bush-fallow system has over the years undergone substantial deterioration, particularly in the main gum producing areas of Kordofan and Darfur, as a result of recurring droughts and population pressures around water points where cultivation period is lengthened and ultimately acacia gardens are completely destroyed in many population centers resulting in the partial collapse of the agro-forestry system. The system has also been disturbed due to the relative unattractiveness of gum Arabic farm gate nominal price compared to export nominal price (see Figure1.1 above) a matter which induced farmers to concentrate more on production of other cash crops (groundnuts, sesame & rosella). On the market side, returns from gum Arabic are also continuously declining as a result of a distorted government exchange rate as well as export and pricing policies of high taxes and marketing margins that reduced the price share of the farmers to unacceptable lower level compared with other competing field crops (Figure 1.2).

Consequently, more of the land under acacia has been converted into field cropping enterprises, with even more adverse impact on gum production. Due to the fact that agricultural land will no longer enjoy the protection of acacias, soil erosion and deterioration of fertility will accelerate. The natural outcome is thus decline in crop productivity, diminishing growth of farm income, which represents real threats to the farm households’ ability to secure their food needs and put them in the poverty trap. Thus, the current dilemma of small farmers in gum belt in our view, could be mainly attributed to the agricultural commercialization policy which indirectly dictating the grown cropping pattern.



Source: Adopted from Elamin et. al. (2000)

Figure 1.2: **Average Nominal Protection Coefficients for Selected Export Crops and the Effective Exchange Rate in Sudan for Selected Time Periods**

Accordingly, this research study make an effort to solve the policy paradox of market orientation of the agricultural products to the benefits of the Federal and State governments and to the benefits of farmers in the gum belt, respectively. The essential underlying argument is recognition of the fact that deterioration of the gum belt in Sudan is a serious problem that threatens the sustainability of the traditional agricultural system as well as livelihood of about 41% (GAC, 1998) of Sudan total population who lives in the gum belt.

2 METHODOLOGY

2.1 Study Area

According to the present Federal governing system in the Sudan, Kordofan region consists of two states North and South Kordofan state. Geographically, it lies between latitudes 9° and 16° 30' N and longitudes 27° and 32° 25' E within the gum belt zone. It is about a total area of 380,000 km^2 (Dunston; Diriba, & Gafaar, 1997). The study area is located in the North Kordofan state with area of about 296,675 km^2 occupied with total population estimated at 3.7 Million people 13% of which are urban, 4% nomads and 63% are rural-settled. The population density is 9.7 persons per km^2 compared to the national level (12 persons per km^2) and the population growth rate is 1.7% with total fertility rate of about 6 children per a woman (UNFPA 2003).

2.2 Analytical Techniques

This paper used the Two-Stage-Least Squire Model (2SLS) to examine the impact of commercialization on the farms' resources allocation decision and the Quantitative Response (QR) "Probit" Model to reveal factors which influence the decision on the land use system. In this paper, farmers in the gum belt face a decision of whether to practice the gum agro-forestry system.

2.2.1 Agricultural Commercialization Model

The term commercialization defines the volume of produce and household resources that enter the exchange economy which may include sales or barter of farm products not used for subsistence and off-farm employment of labor and capital (von Braun et. al. 1994). To assess commercialization orientation in the surveyed household sample, the Agricultural Commercialization Index (ACI) measurement concepts have been used, which is defined as the value of agricultural product sales divided by total value of crop production. Accordingly, OLS estimation was used to identify factors, which influence the commercialization decision of the

farmers. Then, two-stage least square estimation (2SLS)[1] was used to determine the effects of agricultural commercialization on per capita food production. The ACI function is given by:

$$ACI_i = \alpha_\circ + \alpha_n \sum_n^1 X_n + \alpha_m \sum_m^1 A_m + e_i \qquad 2.1$$

Where X_n is a set of exogenous household variables: X_1, per capita land area (ha.); X_2, number of adult equivalent (in man-days); X_3, head household education (1 = yes; 0 = otherwise); X_4, off-farm income (£SD[2]); X_5, livestock capital (£SD); X_6, transportation cost ((£SD/kg); X_7, credit accessibility (1 = yes; 0 = otherwise); X_8, gum agro-forestry system practicing (1 = yes; 0 = otherwise), X_9, extension service availability (1 = yes; 0 = otherwise); X_{10}, obtained subsidy (1 = yes; 0 = otherwise); X_{11}, children number and X_{12}, land acquisition (1 = inheritance; 0 = otherwise). The instrumental variables vector (A_m) represented by A_1, credit accessibility (1 = yes; 0 = otherwise); A_2, head household education (1 = yes; 0 = otherwise); A_3, land acquisition (1 = inheritance; 0 = otherwise); A_4, obtained subsidy (1 = yes; 0 = otherwise); A_5, children number; A_6, transportation cost (£SD/kg); and A_7, adult number (in man-days). And α_o, α_n and α_m are the unknown coefficients to be estimated for the constant, explanatory variables (X_n) and instrumental variables (A_m), respectively. e_i is residual term. The model's second stage equation, production function, can be written as:

$$Y_i = \beta_\circ + \beta_n \sum_n^1 X_n + \beta \sum_i^1 A\hat{C}I_i + v_i \qquad 2.2$$

Where Y_i, is the per capita food crop output value (£SD) X_n, is a vector of exogenous household variables (equation 2.1); $A\hat{C}I$ is the estimated agricultural commercialization index from equation 2.1, endogenous variable; and v_i is residual term.

2.2.2 Gum Agro-forestry System Practicing Model

In commons, QR models are models in which dependent variable is a discrete outcome, such as "yes or no" decision (Green, 1997). In this approach the probit model is analyzed in the general framework of probability models:

$$\text{Prob (event } j \text{ occurs)} = \text{Prob}(Y = j) = F \text{ [relevant effects: parameters]} \qquad 2.3$$

To focus ideas, in our case the respondent either practices gum agro-forestry system ($Y = 1$) or does not ($Y = 0$) in the period in which our survey is taken. We believe that a set of factors, such as age, adult number, per capita land area, gum farm gate price, market distance, farm experience years, off-farm wage rate, number of children in the family and livestock capital, et cetera, gathered in a vector **x** explain the decision so that

$$\text{Prob}(Y = 1) = F(\beta'x)$$

$$\text{Prob}(Y = 0) = 1 - F(\beta'x) \qquad 2.4$$

The set of parameters β reveal the impact of changes in **x** on the probability. Thus, we require a model that will produce predictions consistent with the underling theory in (2.3). The estimating model that emerges from the normal Cumulative Distribution Function (CDF) popularly, known as the probit model (Gujarati, 1988). The probit model is based on the cumulative normal probability function and is defined as

$$\text{Prob}(Y_i = 1) = F(\alpha+\beta X_i) = \frac{1}{\sqrt{2\Pi}} \int_{-\infty}^{\alpha+\beta X_i} \ell^{-u^2/2}\, du \qquad 2.5$$

Where

Prob ($Y_i = 1$) = probability that gum agro-forestry system will be practiced by the i^{th} individual;
F = cumulative normal probability function;

[1] *Developed independently by Henri Theil and Robert Basmann. The basic idea behind 2SLS is to "purify" the stochastic explanatory variable Y_i of the influence of the stochastic disturbance v_i. For more explanation see pp. 686-693 (Gujarati, D. N.. 1995)*
[2] 2.7 £SD = 1 €

U = standard normal deviate with mean zero and variance of one;
β = vector of unknown parameters, and
X_i = vector of independent variables.

It states that Prob (Y_i = 1) is the area under the standard normal curve between $-\infty$ and $\alpha + \beta X_i$. The greater the value of $\alpha + \beta X_i$ the more likely that the i^{th} individual farmer will practice gum agro-forestry system and the reverse is true. The equation below represents the general form of the gum agro-forestry system practice decision model:

Prob (Y_i = 1) = $\beta_\circ$ + β_1AGE+ β_2 WAGE + β_3 CREDIT + β_4CAPLAND + β_5 GUMPR + β_6MKTDIS+ β_7 FARMEXP + β_8 AĈI + β_9 LIVCAP + β_{10} TFARWD + β_{11} EDU + β_{12} CHILD

Where:

AGE	household head age in years
WAGE	household off-farm wage rate in (£SD) per man-day
CREDIT	credit accessibility (1 = yes; 0 = otherwise)
CAPLAND	per capita land area in hectares (a proxy for land fragmentation)
GUMPR	gum Arabic product farm gate price (£SD) per kg
MKTDIS	the near market distance from the village in km
FARMEXP	farming experience years
AĈI	Commercialization Index (%) (Estimated from **2SLS**)
LIVCAP	livestock capital in (£SD)
TFARWD	total on farm working days
EDU	head household years of education
CHILD	children number
$\beta_\circ$, . . ., β_{14}	unknown parameters to be estimated.

2.3 Data and Variables Selection

The analysis applied in this study is mainly based on primary data which collected through field surveys by using structured questionnaires administrated to the farm households during agricultural season of 2004/05. About 108 households were randomly selected and interviewed. Factors like adult, children number and land fragmentation may influence farm household production decisions. Adult number is expected to have positive effect on farm household ACI as well as gum agro-forestry system practice, but it is an ambiguous with respect to food crop production. Land fragmentation, is expected to have negative relation with ACI, agro-forestry practice and food crop production. Households' level of education is expected to be positively related to ACI, but it is an ambiguous in the case of agro-forestry practicing food crop production. Proportion off-farm income is expected to be positively correlated to both ACI and food crop production but negatively related to gum agro-forestry system practice. Household livestock capital is expected to contribute positively to ACI as well as to food crop production and reversely to the gum agro-forestry system adoption. Crop rotation is expected to be positively related to farm agricultural production. Credit accessibility is expected to be positively associated with ACI, food crop production and gum agro-forestry system. Additionally, contact with extension services is expected to have positive effect on all aspects of agricultural production at the household level.

3 RESULTS AND DISCUSSION

3.1 Determinants of Commercialization

The empirical results of agricultural commercialization model in Table 3.2 shows the important factors that influence commercialization decision by farm households. Gum agro-forestry system practice factor is found to be significantly ($P \leq 0.01$) decelerating the agricultural commercialization process. Considering the time span between the planting of Hashab tree and

harvesting of the gum product (6–7 years) as well as the long term rotation of the plantation (20–30 years) only farmers with large holdings will be able to adopt gum agro-forestry; accelerating commercialization induced farmers to convert more of the land under acacia into field cropping enterprises. Gum agro-forestry decision associated with 2.7 percent decrease in the traded agricultural product in the short run (at least one season), at the average.

Contact with extension agents had a significant negative influence ($P \leq 0.01$) on farm household's commercialization decision. This may attribute to fact that government budget constraint limited the influence of formal institutions in remote areas of the country. Hence, the policy implication is that much more emphasis must be placed on the development of stronger research-extension linkages and more direct participation of extension staff in the technology generating process to facilitate integration of the farmers into the market economy.

The ACI decreased significantly ($P \leq 0.05$) by 0.7 percent for every one-kilogram of the agricultural product transported to the market. In Kenya, Omano (1998) observed that the effect of transport costs on cotton production to be enormous. This implies policy that reduces transaction costs such as market development promotes commercialization and construction of roads to increase the accessibility of smallholder to markets during rainy seasons.

The econometric results suggest that the number of years of schooling of the head household to be positively related to the ACI. Controlling for the effects of other factors an additional year invested in education is associated with 2.3 percent increase in the household marketed agricultural product. Basically, development requires change in the attitudes and action of individuals.

Table 3.2: Empirical Results of Commercialization and Food Production Models[1]

Variables	**Equation (2.1): (OLS)**		**Equation (2.2): (2SLS)**	
	Coef.	t-value	Coef.	t-value
Commercialization Index	-	-	0.4***	3.5
Gum Agro-forestry practice	-2.7***	-2.72	-0.3**	-2.07
Per capita land area	-0.4**	-2.04	-0.2	-1.46
Livestock capital	-0.4	-1.02	1.1***	10.46
Off-farm income	0.00004***	2.86	0.2*	1.87
Extension service availability	-3.6***	-3.9	-0.3***	-2.52
Credit accessibility	0.819	0.93	-	-
Obtained subsidy	2.8***	3.29	-	-
Land acquisition	-4.2***	-3.53	-	-
Head household education	2.3***	2.56	-	-
Number of adult	0.5**	2.14	-	-
Pesticide Cost	-0.004***	-3.42	-	-
Children number	-4.8**	-2.19	-	-
Transportation cost	-0.7**	-2.2	-	-
Constant	230.6***	6.68	77645.8***	3.67
N	108	-	108	-
Adjusted R-square	0.45	-	0.56	-
F-value	5.47***	-	23.72***	-

[1)] ****, ** & * denotes statistical significance (one tail test) at 1, 5 and 10 percent level of significance, respectively.*

There is a significant ($P \leq 0.05$) negative relationship between children number and a farmer commercialization decision. An increase of one child in the family size will lead to 4.8 percent decrease in household sold-out product. Simultaneously, number of adults shows positive and significant ($P \leq 0.05$) influence on market participation decision of the farmers. Keeping other factor constant, an additional adult member will lead 0.5 percent increase in the amount of output sold by in the market. These results suggest that the government subsidize the farmer community

by providing education, health and other social services which will decrease budget allocated to such services.

The pesticide cost is found to be significant ($P \leq 0.01$) and negatively related with commercialization decision. One £SD spent on one kilogram of pesticide will lead to 0.004 percent decrease in household market participation. The use of pesticide raises the unit cost of production by increasing the total cost of production, hence decreases farmers' profit. While, subsidy in terms of improved seeds is found to be significant ($P \leq 0.01$) and positively related with commercialization decision. One kilogram increase in the amount of improved seed of cash crops will lead to 2.8 percent increase in household market participation. For policy implication, provision of improved seed subsidy should be combined with financial support to other farming activities to enable the farmers to work in such degraded environment. Another significant variable is off-farm income, which is positively associated with commercialization decision, although its influence is so small. The participant farmers mentioned off-farm income as a key reason for abandonment of the gum agro-forestry system practice (Rahim 2005), this result support the negative influence of agro-forestry practice factor on commercialization process.

Land acquisition variable was also found to be important, as there is a negative association of size of inherited land and commercialization. Land tenure in terms of acquisition, exchange of rights and transfer in the study area is governed by customary rules and regulations (El-Dukeiri 1997). It has been argued that distortions to individual incentives under customary land tenure may cause serious underinvestment in land but customary land tenure institutions may evolve towards greater individualization with more secure individual rights (Ault & Ruttman 1979). The policy implication, is that individual and transferable land title are usually regarded important for including immobile land-related investment such as tree planting and conservation, therefore land title regulation is strongly needed to conserve and maintain the gum agro-forestry system.

3.3 Impact of Commercialization on Household Food Crop Production

Results in Table 3.2 also highlight the complementary relationship between agricultural commercialization index and food production at the household level. One-percent increase in the commercialization index was associated with 0.4 percent increase in the mean value of per capita grain product. That is because framer households were able to use part of the inputs, which provided by the credit institutions, for food crop production. This finding is consistent with empirical findings from Zimbabwe, Kenya, Mali, Senegal and Mozambique where robust complementary relationships were found between household-level cash cropping and food crop performance (Govereh et. al. 1999; Strasberg et. al. 1999; Dione 1989 & Kelly et. al. 1995).

This study found positive significant ($P \leq 0.01$) impact of investment in animal on food crop. One-percent increase in the household livestock capital tended to increase per capita food crop product value by 1.1 percent reflecting strong complementarily between crop and livestock production in this mixed, crop-livestock system. Accordingly, the policy design should consider other activities besides cash cropping intensification to support small farm household food crop production through encouraging livestock production taking into account the vulnerability of production environment in the gum belt of western Sudan.

Extension accessibility variable is negatively and significantly ($P \leq 0.01$) influence per capita food crop output. Usually, unstable development process under the shade of civil war and tribal conflicts in the study area and regime financial limitation constricted the influence of the extension unit activity in outlying areas of the Sudan. The importance of this result lies in its potential use in policy to promote household agricultural production via commercialization by improving household access to extension service. Off-farm income has a positive and significant ($P \leq 0.01$) effect on per capita grain product value. One additional £SD earned from off-farm work, on the average, is associated with 0.2 percent increase in farm household per capita food crop output value.

3.4 Determinants of Gum Agro-forestry System Practice

This part discusses the empirical findings related to farm household gum agro-forestry practicing decision. Table 3.2 shows the results of probit model considering collinear variables not to be involved in the same specification. In this study extension was found to be not significant determinants of gum agro-forestry system practice. Meanwhile, credit is significant ($P \leq 0.05$) determinant of farmer decision towards gum agro-forestry system adoption. Thus, it is strongly recommended to design agricultural financing program focuses on gum agro-forestry system practice in order to stimulate the farmer land investment decision. Also, the empirical results reveal the significant ($P \leq 0.10$) of land fragmentation as a factor which discourage gum agro-forestry practice decision. This means that farms with a large number of fragments, then it is unlikely to practice agro-forestry system. The total working days allocated for field crops production have negative significant influence at 5% level in agro-forestry practicing.

Table 3.2: Probit Coefficient Estimates for Determinants of Gum Agro-forestry System Practice

Variable	Coefficient Estimate	Standard Error	z-Value
Constant	119.26***	44.6462	2.67
Extension	-1.83	1.5526	-1.18
Credit	3.93**	1.9068	2.06
Off-farm Wage Rate	0.01	0.0052	1.49
Head Household Age	-0.08	0.0781	-0.96
Land Fragmentation	-0.24*	0.1305	-1.85
Gum Farm Gate Price	0.01***	0.0043	2.59
Market Distance	0.07**	0.0290	2.27
Farm Experience	0.28***	0.1129	2.5
Commercialization Index	-1.34***	0.4983	-2.7
Livestock Capital	0.00	0.0000	-1.55
Total Agricultural Working Days	-0.09**	0.0389	-2.42
Education	6.78**	2.8424	2.39
Children	-0.34	0.2279	-1.51
Pseudo R^2	**0.74**		
Log likelihood	**-17.5**		
LR $chi^2(14)$	**99.54*** **		
Number of Observation	**108**		

*** Significant at 1%; ** Significant at 5%; & * Significant at 10%

The longer farming experience amongst older farmers is expected to have a positive effect on adoption (Lapar & Pandey 1999; Rahim et. al. 2005). Ghadim and Pannell (1999) presented a conceptual framework which shows learning over time to be a significant factor in agro-forestry adoption. Empirical results of this research confirmed positive effect of farming experience on gum agro-forestry system adoption at 1% level of significance. Moreover, a significant and positive effect for education on the practicing decision is expected. Feder et. al. (1985) argues that higher education levels may be associated with better information on the conservation measurement and more management expertise.

Market distance is found to be a significant determinant of practicing; farmers living further away from the market are more expected to practice gum agro-forestry; this result supported by Rahim (2005) finding. This result is justified by that farmers remotely-located have less access to off-farm employment and are disincentive to sell other extracted products rather than gum Arabic as charcoal and acacia wood which highly demanded as building materials for the tradition village housing, hence are more likely to implement gum agro-forestry to broaden their horizon of income sources and have some hedging against the risk associated with mono-cropping system.

An additional significant variable ($P \leq 0.05$) is total working days for production of annual crops, which is found to be negatively associated with adoption decision. Labor is frequently cited in the

adoption literature as a constraint to agro-forestry systems, because in many cases labor need for tree management operation coincides with labor demand for agricultural operations (Current et. al. 1995). However, in the case of gum agro-forestry system most labor input for the production of gum occurs during the dry season when there is little work in other agricultural crops and most off-farm labor in addition the seasonal migration occurs. The key findings of this research paper are that significance influence of agricultural commercialization index (ACI) and gum farm gate price. The ACI is found to have negative effect on gum agro-forestry practice at significant level of 1%. Conversely, gum farm gate price is significantly ($P \leq 0.01$) and positively influences the farmer decision of agro-forestry adoption. Rahim et. al. (2005) confirmed that many farmers mentioned low gum returns as the main reason for abandoning the system.

4 Summary and Conclusions

In this paper agricultural commercialization at the household level significantly and negatively influence gum agro-forestry system practice decision of the farmer, through providing wrong price signal by pushing the production of cash crops in the short run, while more of the land under acacia has been converted into field cropping enterprises, with even more adverse impact on gum production in the long run. Due to the fact that agricultural land will no longer enjoy the protection of acacias, soil erosion and deterioration of fertility will accelerate. The natural outcome is thus decline in crop productivity, diminishing growth of farm income, which represents real threats to the farmers by leading them to the poverty trap and causes deterioration of the traditional gum agro-forestry system.

Two key pathways can be identified by which gum agro-forestry adoption may improve. First, in constrained credit markets and unattractive domestic gum price, state commercialization program conditioned based on the gum agro-forestry system is the main avenue by which the endangered traditional farming system could be rehabilitated besides smallholders can overcome the capital constraints on making investments in key productivity-enhancing inputs (soil) and livestock. Second, also establishment of other related industries in the country is required to create local effective demand for gum Arabic which will help in absorbing the external market price shocks and create stable production environment. Finally, once these investments and commercialized cropping patterns become initiated and incorporated into the gum agro-forestry system activities, this appears to support a dynamic process of natural resource, human and physical capital accumulation and further intensification of input use, thereby enabling further gains in food crop production and income generation.

From this study it can be concluded that, despite frequent criticisms stressing the trade-offs between agricultural commercialization and food crop production, agricultural commercialization has a positive and significant impact on household food production. However, by speeding up transformation of smallholder to be commercialized farmers without considering their limited resources (labor and land); certainly, this will lead to undesirable impact on sustainability of the tradition system of gum agro-forestry. Therefore, the challenge for government policy is to identify and facilitated strategic pathways to create a positive interactions between gum agro-forestry system practice and commercialization development.

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