Factors Influencing Adoption And Intensity Of Bioenergy Crops By Farmers In Northern Ghana: The Case Of Jatropha Curcas

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Outline

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Background

- Access to energy is a crucial component of poverty alleviation, improving human welfare, and raising living standards
- about 68 % (620 million) of the population in SSA do not have access to electricity (IEA, 2014)
- Energy demand is predicted to double from 500 million tonnes oil equivalent (Mtoe) in the year 2000 to 1 000 Mtoe in 2030;
- In SSA, over 80% of electricity generated is from fossil fuels;
- The heavy reliance on fossil fuels raises serious environmental issues such as depletion of non-renewable resources, Ozone depletion and global warming;

Background (Cont'd)

- Alternatives to fossil fuels: Wind power, solar, bioenergy, etc
- Bioenergy is all energy derived from organic matter (FAO, 2004)
- African countries with bioenergy policies: South Africa (2007), Mozambique (2009), Angola (2010), Ghana (2010).
- Aim of the draft of bioenergy policy for Ghana
  - to substitute national petroleum fuels consumption with **biofuel** by 10% by 2020 and 20% by 2030

Problem Statement

- In Ghana, bioenergy investments have been based on both food and non-food crops: Palm oil, sugarcane, maize, soybean, cassava and Jatropha.

  Advantages (FAO, 2010; Osseweijer et al., 2015)

  - Rural development: create new jobs, increase livelihood and market
  - Diversification of revenue sources from agriculture
  - Security of energy supply and access

  Inconvenients

  - Food insecurity challenges
    - food crops and production inputs are diverted from food production
    - Conversion of land from food to bioenergy crop

Problem Statement (Cont'd)

- Jatropha is a perennial, non-food crop that might contribute in mitigating the challenges of bioenergy
  - Grow on marginal lands
  - Drought resistant
  - Generate energy without compromising food security (Boamah, 2014)
  - Most suitable crop for biodiesel in Ghana
- Numerous Jatropha projects have failed;
  - Large versus small scale
  - Market Identification
  - Poor negotiating position, locked into unfair contract for smallholder farmers
  - Lack of local Jatropha processing firms

Objective

Identify the factors explaining farmers' adoption and land acreage allocation to Jatropha in Northern Ghana

Sampling strategy

- **Stratified random sampling**

1st stage: Purposive selection of Northern Ghana region

2nd stage: Purposive selection of 2 Jatropha growing districts in Northern Ghana: Mion & West Mamprusi(WM)

3rd stage: Random selection of 200 Jatropha farmers:

120 (WM), 80 (Mion) based on Yamane's formula of sample size

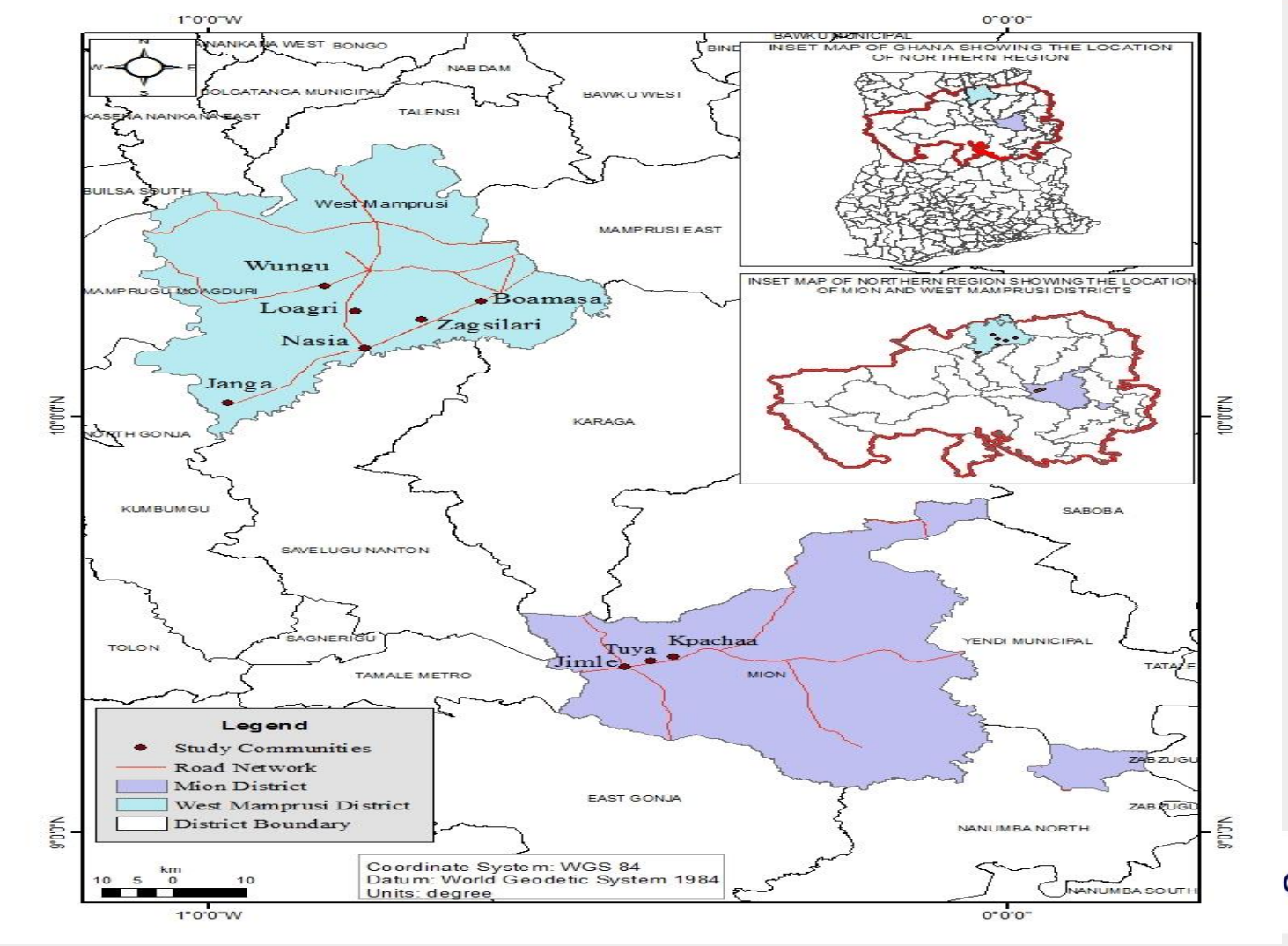
$$n = \frac{N}{1 + N(e)^2}$$

- In each community where the Jatropha farmers were surveyed the equal number of non-Jatropha farmers was also randomly surveyed
- The selection of non Jatropha farmers was based on a sample list provided by community leaders

Distribution of respondents per district and community

District	Community	Adopters	Non-adopters
West Mamprusi District	Zagsilari	20	20
	Nasia	19	19
	Boamasa	20	20
	Janga	20	20
	Wungu	20	20
	Loagri	21	21
Mion District	Jimle	47	47
	Kpachaa	30	30
	Tuya	03	03
	Total	200	200

Map of study area



Theoretical framework

Random Utility Theory (RUT)

- According to the state of adoption, household h utility is approximated as:

$$\begin{cases} U_{hA} = f\left(Z_h\right) + \varepsilon_{hA} \\ U_{hN} = f\left(Z_h\right) + \varepsilon_{hN} \end{cases}$$

- A household h will choose to adopt Jatropha only if the utility derived from adopting is greater than the utility from not adopting: $U_{hA} \succ U_{hN}$

Method

Double hurdle model

- 1st step: Decision to adopt Jatropha or not (Participation equation)

$$y_i^* = \beta X_i + v_i$$

- 2nd step: Decision on the total amount of land allocated to Jatropha (Intensity equation)

$$z_i^* = \gamma W_i + \varepsilon_i \qquad z_i = \begin{cases} z_i^* & if \quad y_i^* \succ 0 \\ 0 & otherwise \end{cases}$$

Explanatory variables

Variable	Definition and measurement	Expected signs
Gender	Gender of the respondent 0 = male, 1 = female	-
Age	Age of the respondent (in years)	-
Education	Level of education of the respondent in years	+
Number of adults	Number of adult members of the household (Count units)	+
Farming Experience	Farming experience of the respondent (years)	+
Farm Size	Farm size (hectares)	+
Extension Services	Number of times the respondent had access to ext. sces	+
Off-farm Activities	Engagement in off-farm activities 0 = No, 1 = yes	+
Livestock	Livestock ownership 0 = No, 1 = yes	-
FBO	Farmer based organization membership 0 = No, 1 = yes	+
District	0 = Mion, 1 = West Mamprusi	+
Credit Access	Access to credit 0 = No, 1 = yes	+
Distance to Market	Distance from home to the nearest agricultural market (in km)	-/+
Size of land owned	Size of land owned (in hectares)	+
Hired Labour	Number of man-days hired during 2014 cropping season	+
Irrigation	Practice of irrigation 0 = No, 1 = yes	+
Risk Attitude	Degree of Risk attitude	+
Discount Factor	1=preference for present , 0 otherwise	-

Results

- Being located in West Mamprusi District significantly reduces the adoption of Jatropha by 13.8%.
- On average, the probability of Jatropha adoption increases by 6.9% each time the farmer has access to extension services (Goswami & Choudhury, 2015)
- Engagement in off-farm activities decreases the probability of Jatropha adoption by 10.3%
- Membership of a FBO significantly increases the probability of Jatropha adoption by 20%

Results (Cont'd)

- The more risk loving the farmer is, leads to an increase of the probability of Jatropha adoption by 2.9% compared to being a risk avoider
- Being a female farmer significantly decreases Jatropha land acreage allocation by 0.12 hectare compared to being a male.
- Access to credit increases Jatropha land acreage allocation by 0.093 hectare

Results (Cont'd)

Variables	Probit		Truncated Regression	
	Marginal Effect	Standard Error	Marginal Effect	Standard error
Gender	0.098	0.070	-0.121**	0.053
District	-0.119**	0.061	-0.138***	0.052
Education	0.009	0.006	-0.001	0.004
Age	0.005**	0.002	0.002	0.002
Number of adults	0.009*	0.005	0.002	0.004
Farming Experience	-0.000	0.002	-0.003	0.002
Farm Size	-0.039	0.026	-0.023	0.022
Extension Services	0.069***	0.024	0.016	0.015
Off-farm Activities	-0.103**	0.049	-0.006	0.040
Livestock	0.033	0.050	-0.063	0.003
Credit Access	0.014	0.064	0.093*	0.049
Distance to market	-0.000	0.004	-0.006**	0.003
Hired Labour	0.000***	0.000	-0.000	0.000
Size of land owned	0.022	0.028	0.036	0.024
FBO	0.201***	0.051	0.019	0.039
Risk Attitude	0.029***	0.010	0.003	0.008
Discount factor	-0.061	0.062	0.015	0.049
Irrigation	-0.015	0.159	0.141	0.128
R^2				
Observations		400	200	
Pseudo		0.1269		
p-value χ^2		0.000	0.000	

Conclusions and recommendations

- Access to extension services, credit, FBO membership, risk preferences are key factors of Jatropha adoption in Northern Ghana
- Extension and education programmes and access to credit mechanisms should be developed to promote adoption of perennial bioenergy crops.
- The development of farmer-based organizations is recommended in order to support Jatropha farmers through trainings and finance and thus increasing their negotiating power.
- Better incentives framework enhancing the benefits of Jatropha cultivation should be put in place such as the availability of Jatropha oil extraction machine so that vulnerable groups such as youth and women would get in.

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Thank You