

Capacity Building in Digital Mapping and GIS for Boosting the Agricultural Sector: Development of GIS-driven Horticulture Produce Information System for Managing the Export Sector

**Joseph Yeng FAALONG, Mawuli AGBOKA, E. AMAMOO-OTCHERE
and B. AKUETTEH, Ghana**

Key words: GIS in Traceability Information System, Food Safety Monitoring

SUMMARY

There are on-going attempts to shift Ghana's agricultural economy's dependency on few traditional export crops. The shift is towards high value horticultural crops among which the pineapple export sub-sector has taken a good lead and promises to succeed. A number of initiatives are being carried out by development partners for safe-guarding the pineapple export market.

Among these initiatives are:

- World Bank assisted Horticulture Export Industry Initiative – Capacity Building of the Ministry of Food and Agriculture for support to small scale growers.
- USAID-sponsored “Trade and Investment Promotion in Competitive Export Economy (TIPCEE), an initiative for accessing the US fruit market.
- COLEAP/PIP support to the Pineapple exporters' access to the EU fruit market.

The main feature of the various initiatives is the development of crop management monitoring system as part of the Traceability Information System required for ensuring agronomic and ethical standards in fruit production and supply to the US and European markets. The Traceability Information System requires digital mapping and GIS-driven database development, which in turn requires compilation of digital plot maps of the growers' farms, agronomic and produce packaging practices database for food safety monitoring and evaluation according to the standards required of the horticulture producer/supplier by the consumer associations.

The mapping and GIS phase is establishing the farm maps and spatial analysis for choosing the best locations for the Pack Houses to which the growers and exporters will send the produce for export handling under the acceptable standards. The initial work has led to the database, which has been used already for creating the scenarios for choosing the Pack House Location options. The presentation captures the processes.

Capacity Building in Digital Mapping and GIS for Boosting the Agricultural Sector: Development of GIS-driven Horticulture Produce Information System for Managing the Export Sector

**Joseph Yeng FAALONG, Mawuli AGBOKA, E. AMAMOO-OTCHERE
and B. AKUETTEH, Ghana**

1. INTRODUCTION

Ghana Government, through the Agricultural Services Sub-sector Investment Programme (AgSSIP) of the Ministry of Food and Agriculture (MOFA), supported by the World Bank, is implementing the Horticulture Exports Industry Initiative (HEII), which aims at supporting the growth and development of Ghana's Horticulture Export Industry. This project is making investments in key areas that will set the basis for accelerated development of the horticulture industry.

The MOFA has to develop a GIS-capacity as part of its project planning, implementation, monitoring and evaluation system.

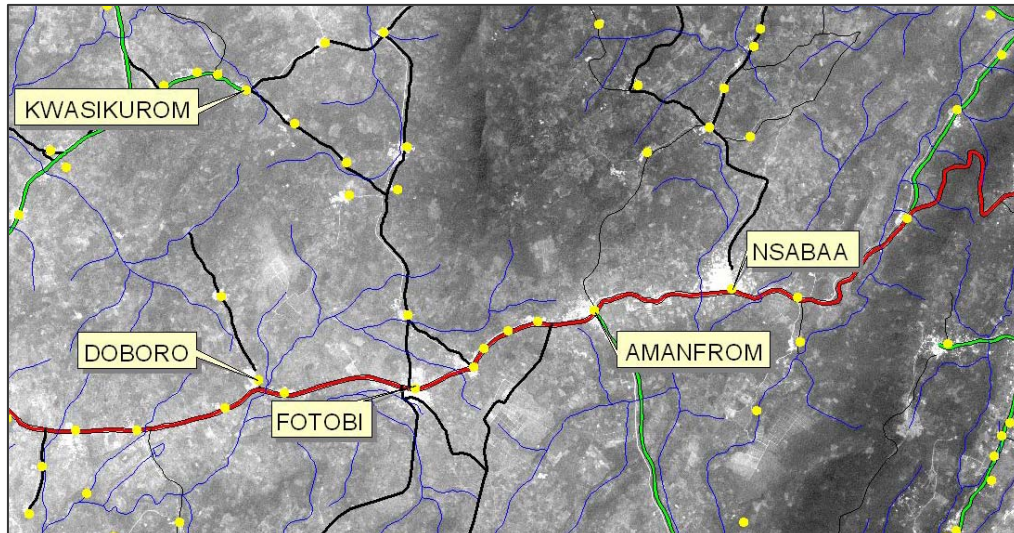
2. OBJECTIVES

The main objective of AgSSIP-HEII is summarized as follow:

- Creation of a GIS-based DBMS for specific production areas.
- Development of a grower database for the management of MD2 multiplication, distribution and diffusion.
- Siting of produce pack-house based on map analysis of distribution of the growers in relation to other location facilities.
- Survey of location, acreages and plant population of other fruit trees (mangoes, citrus, papaya)
- Survey and mapping of pests and diseases of mangoes, etc

3. FIELD DATA SURVEY

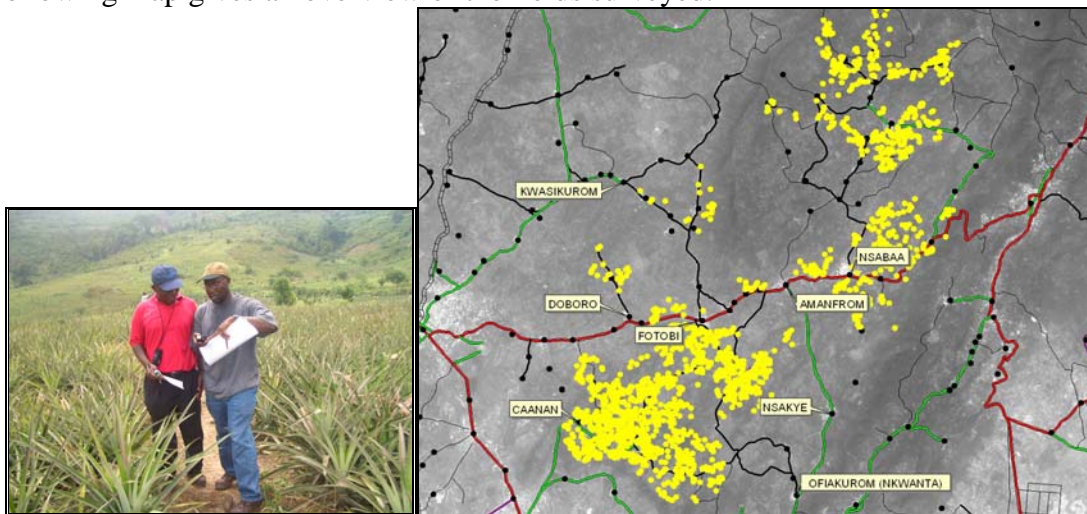
During the month of May 2005, a field survey was carried out in a small region north of NSABA and FOTOBI as displayed on the following map:



Map 1: Area of Interest for the preliminary survey

The purpose of this survey was to locate and register field centres and farmer cultivating Pineapple. Using GPS techniques, the surveyors were asked to register the centre of each field with an estimation of the surface under pineapple cultivation. A total of 1786 fields were surveyed and entered in a GIS database.

The following map gives an overview of the fields surveyed.



Map 2: Centres of the 1786 surveyed fields

For each field the following information were recorded:

- Geographic Coordinates of the field centre
- Name of the Farmer
- Address of the farmer
- Estimated Acre for each field

4. DEVELOPMENT OF A GROWER DATABASE

CODE	OFFICER	DISTRICT	NAME OF FARMER	NAME OF FARM	APPROX. ACRES	VILLAGE	FARM DISTRICT	Fenced	Water	Electricity	Road	Fertilizer	Farm
001	ROBERT AIDOO	AKWAPIM SOUTH	SAMPSON		0.34	FOTOBII	AKWAPIM SOUTH	Y	Y	Y			
002	ROBERT AIDOO	AKWAPIM SOUTH	ASODZI FRANCIS	ASODZI	1.50	FOTOBII	AKWAPIM SOUTH	Y	Y	Y			
003	ROBERT AIDOO	AKWAPIM SOUTH	CHRISTIAN AYITEY	CHRISTIAN	2.50	FOTOBII	AKWAPIM SOUTH	Y	STREAM	Y			
004	ROBERT AIDOO	AKWAPIM SOUTH	ASODZI FRANCIS	ASODZI	0.70	FOTOBII	AKWAPIM SOUTH	Y	Y	Y			
005	ROBERT AIDOO	AKWAPIM SOUTH	KOFI CHIKPE	CHIKPE	0.45	FOTOBII	AKWAPIM SOUTH	Y	Y	Y			
006	ROBERT AIDOO	AKWAPIM SOUTH	PANA		0.40	FOTOBII	AKWAPIM SOUTH	Y	Y	Y			
007	ROBERT AIDOO	AKWAPIM SOUTH	KOFI CHIKPE	CHIKPE	0.45	FOTOBII	AKWAPIM SOUTH	Y	STREAM	Y			
008	ROBERT AIDOO	AKWAPIM SOUTH	AYITEY CHRISTIAN	CHRISTIAN	2.00	FOTOBII	AKWAPIM SOUTH	Y	Y	Y			
009	ROBERT AIDOO	AKWAPIM SOUTH	WILLIAM GEMETI	WILLIAM	6.00	FOTOBII	AKWAPIM SOUTH	Y	STREAM	Y			
010	ROBERT AIDOO	AKWAPIM SOUTH	CHARLES BOATENG		1.40	FOTOBII	AKWAPIM SOUTH	Y	Y	Y			
011	ROBERT AIDOO	AKWAPIM SOUTH	PETER AHADJU		2.00	FOTOBII	AKWAPIM SOUTH	Y	STREAM	Y			
012	ROBERT AIDOO	AKWAPIM SOUTH	SIKPE JOHN'S		3.00	FOTOBII	AKWAPIM SOUTH	Y	Y	Y			
013	ROBERT AIDOO	AKWAPIM SOUTH	SIKPE JOHN'S		1.00	FOTOBII	AKWAPIM SOUTH	Y	Y	Y			
014	ROBERT AIDOO	AKWAPIM SOUTH	PETER AHADJU	PETER	0.32	FOTOBII	AKWAPIM SOUTH	Y	STREAM	Y			
015	ROBERT AIDOO	AKWAPIM SOUTH	ASODZI FRANCIS	ASODZI	0.45	FOTOBII	AKWAPIM SOUTH	Y	Y	Y			
016	ROBERT AIDOO	AKWAPIM SOUTH	KWASI OPOKU		1.00	FOTOBII	AKWAPIM SOUTH	Y	Y	Y			
017	ROBERT AIDOO	AKWAPIM SOUTH	KWASI OPOKU		1.00	FOTOBII	AKWAPIM SOUTH	Y	Y	Y			
018	ROBERT AIDOO	AKWAPIM SOUTH	EDDAN	KWASI	1.00	FOTOBII	AKWAPIM SOUTH	Y	Y	Y			
019	ROBERT AIDOO	AKWAPIM SOUTH	AKU ADAGBATSE		0.35	FOTOBII	AKWAPIM SOUTH	Y	Y	Y			
020	ROBERT AIDOO	AKWAPIM SOUTH	ANDRI JOSEPH		0.42	FOTOBII	AKWAPIM SOUTH	Y	Y	Y			
021	ROBERT AIDOO	AKWAPIM SOUTH	AMODU ARVEN		0.70	FOTOBII	AKWAPIM SOUTH	Y	Y	Y			
022	ROBERT AIDOO	AKWAPIM SOUTH	DOTSE		1.50	FOTOBII	AKWAPIM SOUTH	Y	Y	Y			
023	ROBERT AIDOO	AKWAPIM SOUTH	AMDAFO	AMDAFO	1.30	FOTOBII	AKWAPIM SOUTH	Y	Y	Y			
024	ROBERT AIDOO	AKWAPIM SOUTH	JOE		0.15	FOTOBII	AKWAPIM SOUTH	Y	Y	Y			
025	ROBERT AIDOO	AKWAPIM SOUTH	JOE		0.25	FOTOBII	AKWAPIM SOUTH	Y	Y	Y			
026	ROBERT AIDOO	AKWAPIM SOUTH	NSAWAM GUY		4.00	FOTOBII	AKWAPIM SOUTH	Y	Y	Y			
027	ROBERT AIDOO	AKWAPIM SOUTH	UNCLE JOD		0.17	FOTOBII	AKWAPIM SOUTH	Y	Y	Y			
028	ROBERT AIDOO	AKWAPIM SOUTH	YAW VICTOR		0.50	FOTOBII	AKWAPIM SOUTH	Y	Y	Y			
029	ROBERT AIDOO	AKWAPIM SOUTH	YAW AMDAFO		1.00	FOTOBII	AKWAPIM SOUTH	Y	Y	Y			
030	ROBERT AIDOO	AKWAPIM SOUTH	AMDAFO		0.70	FOTOBII	AKWAPIM SOUTH	Y	Y	Y			
031	ROBERT AIDOO	AKWAPIM SOUTH	SIKPE JOHN		0.50	FOTOBII	AKWAPIM SOUTH	Y	Y	Y			
032	ROBERT AIDOO	AKWAPIM SOUTH	BOATENG		2.00	FOTOBII	AKWAPIM SOUTH	Y	Y	Y			
033	ROBERT AIDOO	AKWAPIM SOUTH	RICHARD AMARKO		4.00	FOTOBII	AKWAPIM SOUTH	Y	Y	Y			
034	ROBERT AIDOO	AKWAPIM SOUTH	SIKPE JOHN'S	SIKPE	3.00	FOTOBII	AKWAPIM SOUTH	Y	Y	Y			
035	ROBERT AIDOO	AKWAPIM SOUTH	RICHARD AMARKO	RICHARD AMARKO	1.00	FOTOBII	AKWAPIM SOUTH	Y	Y	Y			
036	ROBERT AIDOO	AKWAPIM SOUTH	TOGBYE SASA		2.00	FOTOBII	AKWAPIM SOUTH	Y	Y	Y			
037	ROBERT AIDOO	AKWAPIM SOUTH	SIKPE JOHN'S		2.00	FOTOBII	AKWAPIM SOUTH	Y	Y	Y			
038	ROBERT AIDOO	AKWAPIM SOUTH	SIKPE JOHN'S		2.00	FOTOBII	AKWAPIM SOUTH	Y	Y	Y			
039	ROBERT AIDOO	AKWAPIM SOUTH	ROBERT SAMABIO		1.00	FOTOBII	AKWAPIM SOUTH	Y	Y	Y			
040	ROBERT AIDOO	AKWAPIM SOUTH	KWABENA TSE		0.50	FOTOBII	AKWAPIM SOUTH	Y	Y	Y			
041	ROBERT AIDOO	AKWAPIM SOUTH	KWABENA TSE AMORVE		1.00	FOTOBII	AKWAPIM SOUTH	Y	Y	Y			
042	ROBERT AIDOO	AKWAPIM SOUTH	CEPHAS GAFA		1.50	FOTOBII	AKWAPIM SOUTH	Y	Y	Y			
043	ROBERT AIDOO	AKWAPIM SOUTH	YAW ADETU		0.40	FOTOBII	AKWAPIM SOUTH	Y	Y	Y			

Table of Bio-data of farmers whose fields were captured

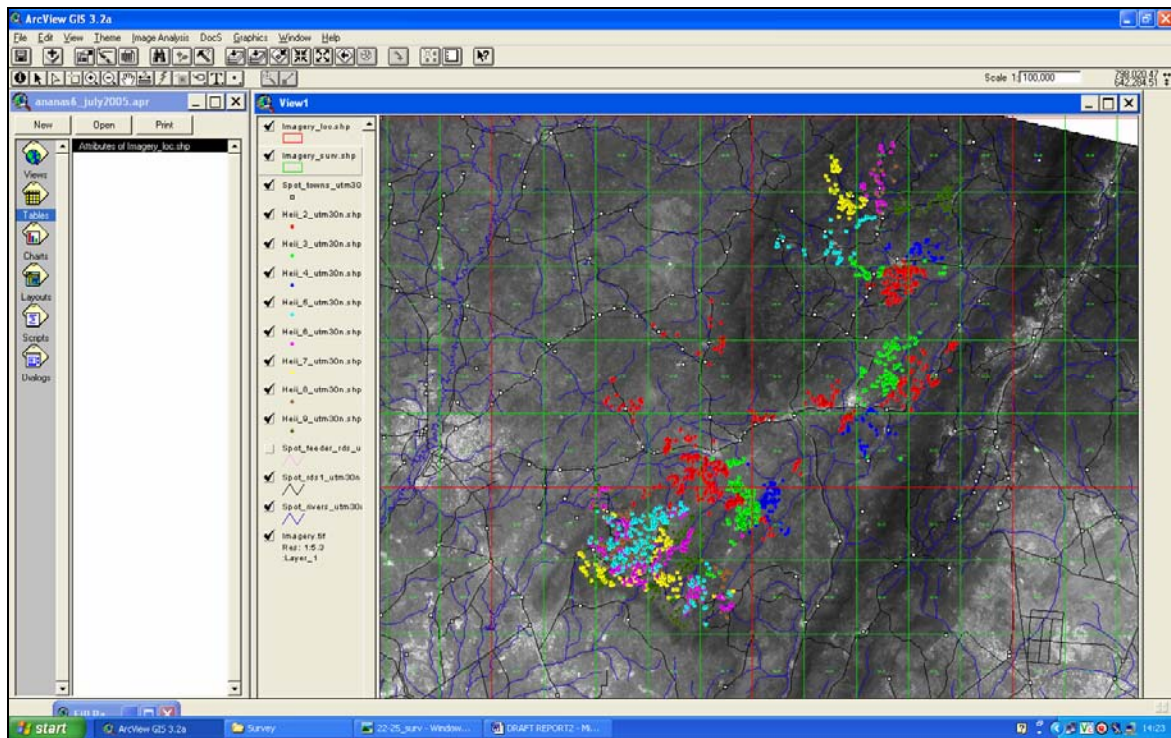
5. PACHOUSE LOCATION

- Preparation of Navigation and location maps for surveyors.
- Preparation of Infrastructure layers
- Integration of data and multi-criteria analysis to determine scenarios of Pack house location.

The system requirements for the integration were the following layers of information:

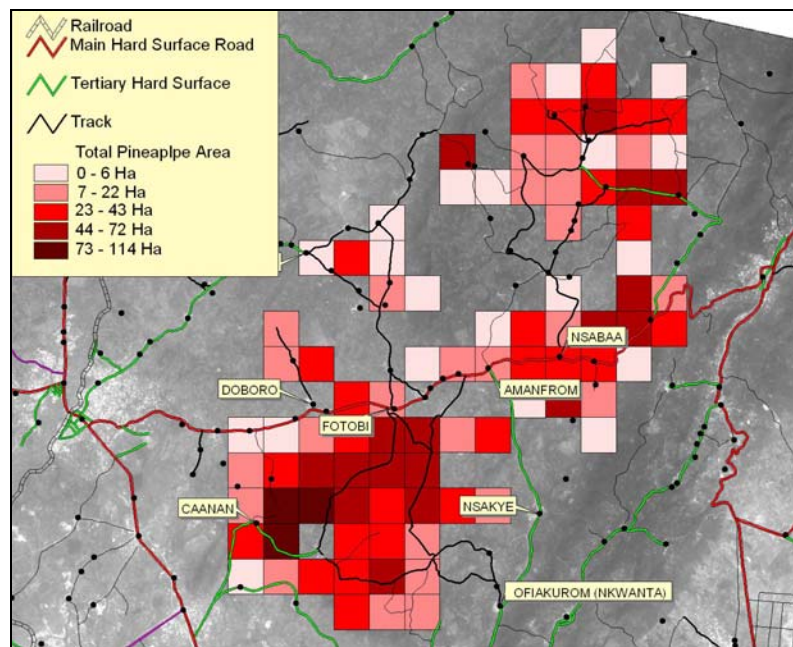
- The most up-to-date road network available over all area of interest and the major roads for Ghana. For the pack house location program, missing roads were completed with roads visible on the satellite imagery.
- The most up-to-date existing data for the electricity grid (ie. settlements with electricity).
- The most up-to-date data for rivers and streams for water availability assessment and settlements with water facilities.
- The most up-to-date towns and villages point data set.

The following map shows the location of pineapple field centres.



Map 3: Navigation/management maps for farm/field boundary collection.

For each field, the surface of pineapple crop was computed and aggregated by 1*1km cell to summarize the information in a clear and readable way. The total area for the 1786 fields is estimated as 3102 Ha of Pineapple and the geographic repartition of these acres is as follow:



Map 4: Pineapple Density map from the field survey

From the previous map, it does clearly appear there are 3 main basins of production:

- Basin 1: South of FOTOBI
- Basin 2: Around NSABAA
- Basin 3: North of NSABAA

In addition, with the super-imposition of the road network on the “Pineapple density Map”, it does clearly appear that the optimal location for the packhouse is NSABAA, which is the weighted centre of the density map taking into account the major roads network in this region.

The project recommends NSABAA, preferably in the western part of the city, as the location of the Packhouse where the following key infrastructures are known to be available:

- Good water source
- Major electricity source
- Telephone connection and above all very good road connectivity towards the 3 major basins of production.

6. FIELD SURVEY PROTOCOL

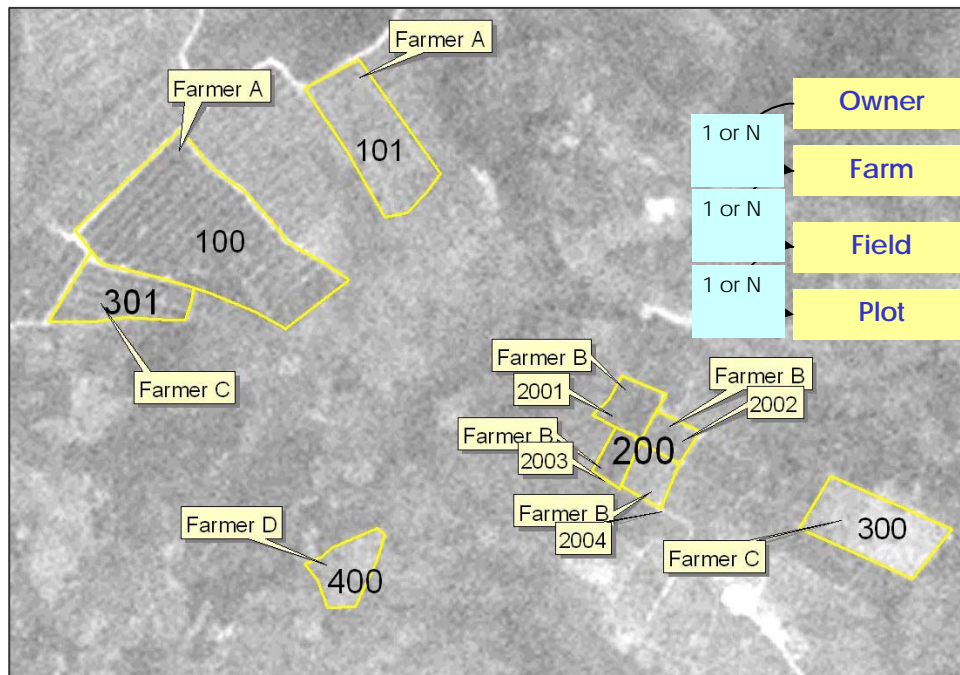
The purpose of the field survey carried out is to collect information at field level to:

- Create an agronomic information database on Pineapple (Crop practices, Yield, Acreage, location, Sugar content, variety...) to feed the informative Web information pages.
- Prepare and evaluate the possibility to implement a traceability system in this area.
- Support the MD2 variety diffusion mapping and record keeping.

Preliminary and Key definition:

One must understand that the geographic database will link “tabular or informative” data to a geographic location. After extensive discussion with the stakeholders, it was agreed that the geographic unit to be mapped and used in the geographic database is a field plot.

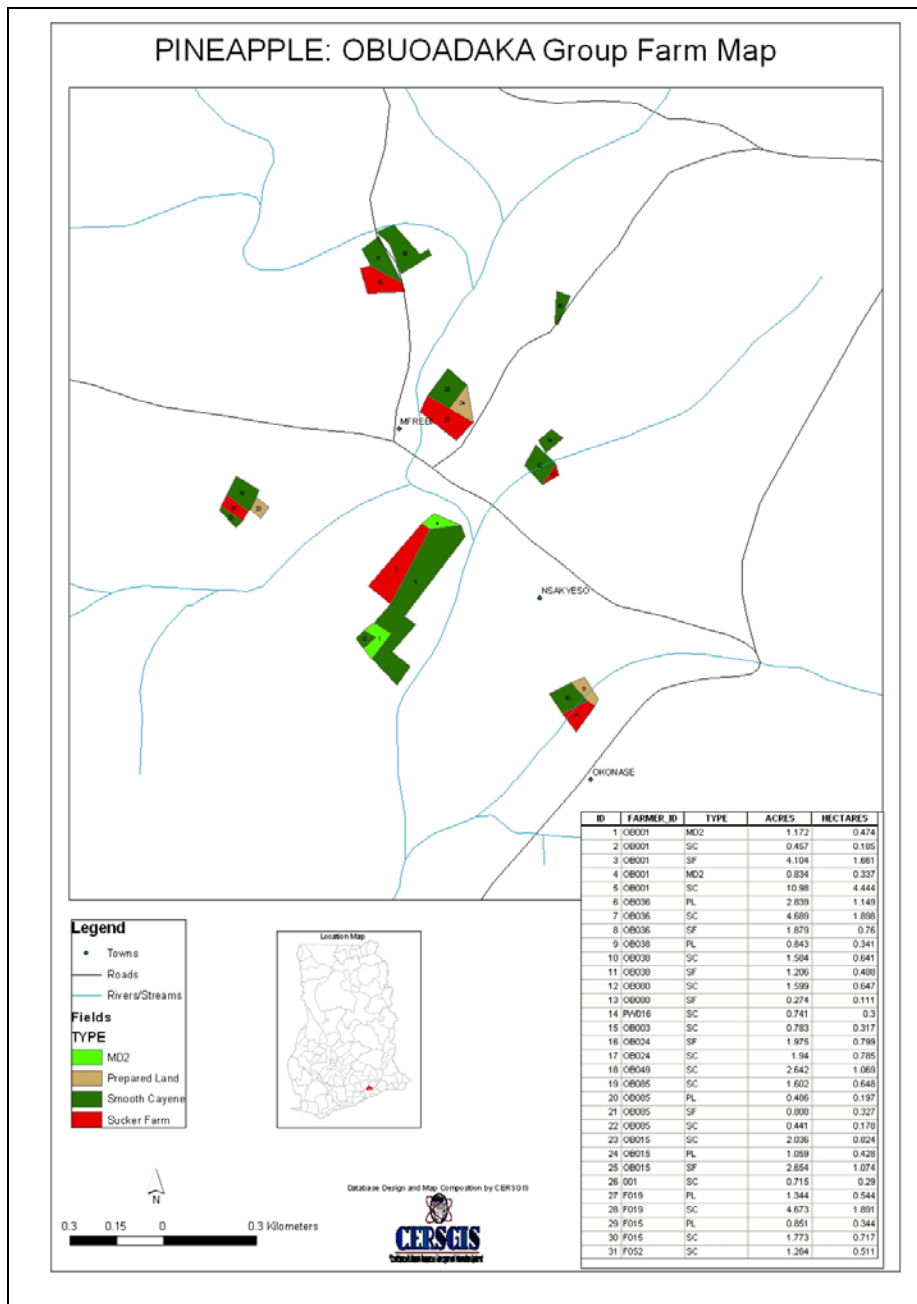
A field plot is defined as: A contiguous area of pineapple planted at the same time / same growth stage and same variety within a clearly defined boundary.



A Farmer can possess several farms or location within a village or several villages. Within each farm the farmer can have one or several fields and each field can have one or several plots.

7. RESULTS

One specific area of immediate application of the GIS capacity is in the pineapple export sector, which is faced with a tracking system for the diffusion of MD2 and multiplication. To achieve this, farmer groups who have shown interest have had their farms mapped at field level showing which variety of pineapple planted, acreage and prepared land. The result of the mapping is being used as input for decision making for the distribution of the right amount of MD2 plantlets to be supplied to the farmer groups. The GIS-driven database will be used as a spatial decision support tool in the administration, planning and dissemination/diffusion process of the MD2 variety.



Map 5: Obuoadaka Group Map showing Pineapple farm/field area, pineapple variety, etc

8. CONCLUSION

In the long term, the GIS initiative will be to develop capacity within AgSSIP-MOFA as well as a strong capacity within industry in the supporting of state and associative agencies in documenting, managing and monitoring distribution production systems.

The ultimate is to develop and use a kind of product traceability system that will trace the produce from the farm to the consumers table and vice versa.

CONTACTS

Joseph Yeng Faalong
HEII, Ministry of Food and Agriculture (MOFA)
GHANA
Email: xtie67@yahoo.com