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# AN AGROFORESTRY SYSTEM IN GULU (NORTHERN UGANDA)

## UN SISTEMA AGROFORESTAL EN GULU (NORTE DE UGANDA)

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**ABSTRACT**

Gulu is a rural area of Northern Uganda, characterized by poverty and insufficient food availability. The climate is warm and rainy, and the soils are fertile. Nonetheless food production is done with simple practices and could be increased much. Research has been planned at the University of Florence, voluntarily funded for local development by Italian companies operating in the Country and organizatively supported by a local Uganda company. The data was collected thanks to the help of Italian NGOs at the moment working in the area. The research has been based in the Saint Isidoro Farm and nearby area. On the base of a participative research approach some tree species have been chosen for intercropping with field crops. The chosen species are *Mangifera indica, Persea americana, Moringa oleifera, Azadiractha indica*, *Musa* spp. hybrids, *Tamarindus indica, Carica papaya, Eucaliptus grandis*, *Tectona* grandis, *Khaya* anthothera). The field crops chosen are sunflower (*Heliathus annuus*), bean (*Phaseolus vulgaris*), maize (*Zea mays*), soya (*Glycine max*), millet (*Panicum miliaceum*), groundnut (*Arachis hypogaea*). An agroforestry system has been proposed with this species, planting trees on each field perimeter, and organizing a 3 years rotation of the field crops within, maintaining two crops each year rotated as well. The inhabitants of the near villages that were interviewed and integrated in the planning procedure, have shown real interest and appreciation for the plan.

**Keywords:** development, tree species, field crops, crop rotation

**RESUMEN**

Gulu es una zona rural del norte de Uganda, caracterizada por la pobreza y la disponibilidad insuficiente de alimentos. El clima es cálido y lluvioso, y los suelos son fértiles. No obstante, la producción de alimentos se realiza con prácticas sencillas y podría aumentarse mucho. Se realizó una investigación en la Universidad de Florencia, financiada voluntariamente para el desarrollo local por empresas italianas que operan en el país y apoyada organizativamente por una empresa local de Uganda. Los datos se recopilaron gracias a la ayuda de ONG italianas que trabajan actualmente en la zona. La investigación se ha basado en la granja Saint Isidoro y sus alrededores. Sobre la base de un enfoque de investigación participativa, se han elegido algunas especies de árboles para intercalar con cultivos de campo. Las especies elegidas son *Mangifera indica*, *Persea americana*, *Moringa oleifera*, *Azadiractha indica*, híbridos de *Musa* spp., *Tamarindus indica*, *Carica papaya*, *Eucaliptus grandis*, *Tectona grandis*, *Khaya anthothera*. Los cultivos de campo elegidos son girasol (*Heliathus annuus*), frijol (*Phaseolus vulgaris*), maíz (*Zea mays*), soja (*Glycine max*), mijo (*Panicum miliaceum*) y maní (*Arachis hypogaea*). Se propuso un sistema agroforestal con estas especies, plantando árboles en el perímetro de cada campo y organizando una rotación de cultivos de campo de tres años en el interior, manteniendo también dos cultivos rotados cada año. Los habitantes de las aldeas cercanas, que fueron entrevistados e integrados en el procedimiento de planificación, han mostrado un interés real por el plan.

**Palabras clave:** desarrollo, especies arbóreas, cultivos de campo, rotación de cultivos

## INTRODUCTION

The area of Gulu in Northern Uganda was plagued with a long civil war from the 80s until June 2006 when peace treaty was signed (Dolan, 2010). Later, troop movements from South Sudan and Congo caused the arrival of estimated number of 1,200,000 refugees and has largely enhanced the critical food condition.

The situation following the war has made the region largely depend on UN international aids, and on NGOs development projects, however these organisations and the local Government were too pressed by the emergency situation and had only little interest in agriculture development up to very recent years (Levine & Adoko, 2006). In the meantime, the local "Acholi" native population has continued to crop the land with traditional methods for

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both self-subsistence and social status (Negri & Zanoner, 1980). Unfortunately, forest clearing is a common treat and trees are felled for fuel and timber.

The agricultural system of the region is still based on a strong ethnic component, and every year just before the beginning of the rainy season a Council of elders makes the decisions on cropping species, periods and methods. The main crops are fresh bananas, *Manihot esculenta*, *Zea mays*, *Oryza sativa*, *Phaseolus vulgaris* and *Cajanus cajanus*. Common fruits are *Mangifera indica*, *Carica papaya*, *Persea americana* and *Passiflora edulis*. Livestock rearing is not common, apart for some poultry, but the sector is growing. Timber production is based on *Pinus* spp and *Eucaliptus globulus*, *Tectonia grandis* (Teak), *Diospyros mespiliformis* (Eban) and *Khaya anthotheca* (African Mahogany).

Deforestation, for the conversion of land into agricultural fields and charcoal production, is an increasingly common practice that puts local biodiversity at risk and increases the level of soil degradation and loss of fertility; over 90% of Uganda's energy comes from fuelwood and charcoal (Josephat, 2018).

This research was conducted in 2019, voluntarily financed by two Ugandan companies and one Italian company which is voluntarily supporting the overall development of a local farm also offering its own experts. The Ugandan companies helped to understand the territory, the society, and the access to local market. Finally, the data were collected with the help of two Italian NGOs operating in the area. The research was done into a recently started farm and took into consideration the conditions of agriculture at present and the possibilities of modernization of the cropping systems.

## MATERIALS AND METHODS

The study was done in the local "Saint Isidoro Farm" started in 1980, then abandoned for 5 years, and now restarted by the diocese of the Catholic Church in Gulu. The farm has a total area of 125 hectares.

Gulu has a tropical climate (Figure 1), always warm temperatures mitigated by altitude (23 C° annual average), a long rainy season and a rather short dry period during which there is some rain nonetheless. The total rainfall of 1507 mm is theoretically enough to feed the fields also in the dry season if water catchment and conservation was done. Irrigation is not common, except for a few very large farms.

The rainfall pattern allows two cropping periods per year. The first period starts with the first rains after the dry season (March) and early varieties can be cropped in July. The second cropping period begins in August and the new crops can be harvested in November before the dry season.

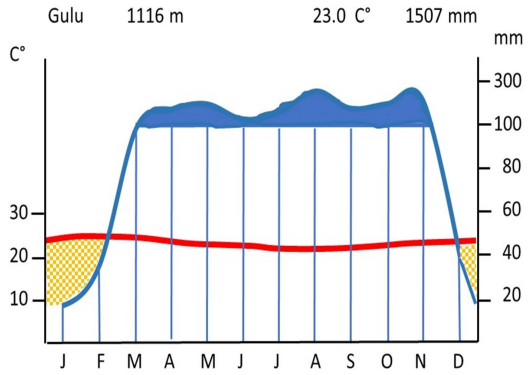


**Figure 1.** Climate-diagram of Gulu (Northern Uganda)

The soils are mainly acric ferralsols and some petric plinthosols (FAO-Unesco WRB classification). pH ranges 5.2 to 6.9 and there is high content of organic matter, probably residual of the former forest and the tree re-colonization occurred during the five years abandon.

A first part of the research (agriculture at present) has been done by questionnaires distributed to local farmers (67 farmers answered), the second part (proposal of an agronomic plan) discussed the needs and the ideas with the Saint Isidoro's management board, with local farmers and technicians, with a participatory research approach.

Our analysis took into consideration:

- The present conditions of local agriculture (67 questionnaires)
- Proposal of an agronomic plan based on sustainable agroforestry techniques (PRA).

## RESULTS AND DISCUSSION

### Present conditions

The farmers pointed some useful effects but also some weakness of the early development projects (Table 1). The perceived benefits are all somehow related to local and international integration; weaknesses were mainly caused by the emergency condition that did not allow to think long term strategies.

### Proposed new agronomic plan

Six fields were designed in the farm. In order to have a sustainable cropping system, trees presence was considered necessary, for both food production, some forage for the few livestock, herbal medicine, timber and reforestation. Intercropping of crops and trees has been proposed for microclimate mitigation, better seasonality of production, diversification of diet, more jobs opportunities. Moreover, rotations have been started to prevent loss of soil fertility and to limit weeds and pest's diffusion; the rotations take consideration of the period (first or second cropping period of the year) and it is arranged on a 3 year rotation.

**Table 1.** Strengths and weaknesses of early development projects in the area, as referred by local farmers.

| Strengths | Weaknesses |
|---|---|
| Availability of international funds.<br>Availability of an emergency food strategy.<br>Access to modern knowledge and technologies.<br>Link with international networks and experts.<br>Deeper knowledge about local resilience and adaptation to difficulties. | Emergency agricultural projects were not assimilated by local farmers.<br>Development projects are always too short to sort an effective and stable result.<br>Up to now interventions were more oriented to emergencies than to a long-term development. |

The crop rotations planned (Table 2) are based on common local crops: Maize (*Zea mays*), soy (*Glycine max*), Sunflower (*Heliathus annuus*), bean (*Phaseolus vulgaris*), Millet (*Panicum miliaceum*), groundnut (*Arachis hypogaea*). These varieties of crops will improve the differentiation of incomes, and the legumes will help to maintain the good fertility of the soil.

Trees were planted in all the fields, both in lines (Alley Cropping) and along the hedges (windbreaks). The species were chosen according to traditions, food needs and other uses, match with the herbaceous crops:

Trees on the borders

Mango (*Mangifera indica*) chosen for fruit, forage, medicine, shadow;

Avocado (*Persea americana*) chosen for fruit;

Eucalyptus (*Eucaliptus globulus*) for fast growing timber, medicine;

Teak (*Tectona grandis*) for quality timber;

African mahogany (*Khaya anthothera*) for quality timber.

Trees in Alleys

Moringa (*Moringa oleifera*) chosen to start an oil production, as vegetable and water purifier, medicine;

Neem (*Azadiractha indica*) chosen to produce an organic pesticide;

Fresh banana (*Musa* spp) chosen for fruit and mulching,

Tamarind (*Tamarindus indica)* chosen for fruit, forage, shadow;

Papaya (*Carica papaya*) chosen for fruit.

The tree species on the perimeters of the six fields are planted at distances of 4 m, alternated (mango - avocado - eucaplyptus - teak - african mahogany) also to increase the biodiversity and a more natural landscape.

The trees planted in alley cropping (moringa, neem, fresh banana, Tamarind, papaya) were planted at a distance of 4 m on the line, and interlines (cropped) of 12 meters.

## CONCLUSIONS

The research has pointed out the weaknesses of early development projects, but also good effects and possibilities of improvement. This understanding will help to better organize next interventions. One of the results points clearly at the too short length of international projects, which 1-2 years' time might be useful in some sectors of interventions but not in agriculture and forestry because natural cycles take always much longer. Two years are enough to start an agricultural project, not to make it grow and not to see much about results.

The discussion with the management board of the farm, local farmers and technicians, has indicated a strong interest for a long-term sustainable cropping system and identified this with an agroforestry system with variety of trees, intercropping and legumes-cereals and sunflower rotation.

**Table 2.** Crop rotation for the 6 fields, first and second crop of the year, three years rotation, in Saint Isidoro Farm.

| | **Field 1** | **Field 2** | **Field 3** | **Field 4** | **Field 5** | **Field 6** |
|---|---|---|---|---|---|---|
| **ha** | 15 | 15,5 | 12,7 | 17 | 14,3 | 14 |
| 1° (1° year) | Sunflower | Maize | Soya | Bean | Groundnut | Millet |
| 2° (1° year) | Bean | Soya | Maize | Sunflower | Millet | Groundnut |
| | **Field 1** | **Field 2** | **Field 3** | **Field 4** | **Field 5** | **Field 6** |
| **ha** | 15 | 15,5 | 12,7 | 17 | 14,3 | 14 |
| 1° (2° year) | Maize | Millet | Bean | Groundnut | Soya | Sunflower |
| 2° (2° year) | Soya | Groundnut | Sunflower | Millet | Maize | Bean |
| | **Field 1** | **Field 2** | **Field 3** | **Field 4** | **Field 5** | **Field 6** |
| **ha** | 15 | 15,5 | 12,7 | 17 | 14,3 | 14 |
| 1° (3° year) | Millet | Sunflower | Groundnut | Soya | Bean | Maize |
| 2° (3° year) | Groundnut | Bean | Millet | Maize | Sunflower | Soya |

The newly planted fields can give good yields in a few years, after which the Saint Isidoro Farm will become also a pilot farm to show modern and conservative techniques to other farms and spread this and similar agroforestry systems in the area.

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