

*Full Length Research Paper*

# Field schools and plant clinics: effective agricultural extension approaches to fight the coconut lethal yellowing disease and improve livelihoods of smallholder farmers in Grand-Lahou, Côte d'Ivoire

<sup>1</sup>Kouamé Daniel Kra\*, <sup>1</sup>Taky Hortense Atta Diallo, <sup>1</sup>Marie Noël Toualy, <sup>1</sup>Koffi Eric Kwadjo, <sup>2</sup>Koulou Epse Yoboua Nazaret, <sup>1</sup>Yadom Yao François Regis Kouakou, <sup>1</sup>Assiri Elloh Patrice Kouamé, <sup>1</sup>Koutoua Séka, <sup>1</sup>Bognan Winnie Miyasi Ouattara, <sup>1</sup>Jonas Guei Ibo, <sup>3</sup>Jean Louis Konan Konan, <sup>4</sup>Yaima Arocha Rosete

<sup>1</sup>Université Nangui Abrogoua, 02 BP 801 Abidjan 02, Côte d'Ivoire, <sup>2</sup>Agence Nationale d'Appui au Développement Rural (ANADER), BPV 183 Abidjan, Rue du chevalier De Clieu, Abidjan-Marcory, Côte d'Ivoire, <sup>3</sup>Station de Recherche "Marc Delorme", Centre National de Recherche Agronomique (CNRA), 07 BP 13 Abidjan 07, Côte d'Ivoire., <sup>4</sup>Sporometrics, 219 Dufferin Street, Suite 20C, Toronto, ON M6K 3J1, Canada.

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Field schools and plant clinics are key extension tools to fight the lethal yellowing disease of coconut that is severely impacting the livelihoods of thousands of smallholder farmers in Grand-lahou, Côte d'Ivoire. Field schools have trained 1,960 men and women farmers on coconut farming, marketing and disease management. Six Women Groups have been created to support women in establishing cassava yards as an alternative food and cash crop. Plant clinics have mobilized circa 600 producers that are willing to pay consultation services to plant doctors. Young farmers foresee plant doctors as a new local job source. The number and diversity of coconut products sold by women farmers through Women Coconut Fairs increased 64% from 2015 to 2016 enabling women to sell and marketing, and to identify small business opportunities. Sex-disaggregated surveys revealed the main gender issues and major constraints associated with the coconut production chain in Grand-Lahou. Field schools and plant clinics are effective approaches to engage farmers, stakeholders and policy makers, and to empower women. These may be also the most suitable platforms to discuss and encourage the implementation of low-cost local interventions on behalf of the farming community.

**Keywords:** Agricultural extension, coconut lethal yellowing, Côte d'Ivoire, field schools, plant clinics.

## INTRODUCTION

Extension, listed as one of the top agricultural priorities for poverty reduction strategy (Inter Academy Council,

2004) is responsible for almost one billion small-scale farmers worldwide, providing them with information, technology, advice, and empowerment (Davis et al., 2010). To address the growing rural poverty and fuel sustainable productivity in the African continent, special efforts have to be made to support extension, agricultural

\*Corresponding author E-mail: [kokranes@gmail.com](mailto:kokranes@gmail.com)

education, and technology transfer in order to assist farmers and stakeholders in problem solving and to obtain information, skills, and technologies for the improvement of their livelihoods and well-being (Birner et al., 2006).

Initiatives such as the farmers field schools have played a fundamental role in agricultural extension. Indeed, FAO included them within the plant protection and phytosanitary measures for Integrated Pest Management (Davis et al., 2010). Field Schools, first developed in Southeast Asia in the 1990s are a very popular extension and education approach worldwide based on 'learn by doing', now in place in at least 78 countries (Braun et al., 2006; Davis, 2006). Field schools are a participatory method of experiential learning, technology development, and dissemination (FAO 2001; Davis and Place 2003). It is also a group approach to facilitate farmers in making decisions, solving problems, and learning new techniques (Davis et al., 2010). Field schools have been attended by at least 10 million farmers in 90 countries, and have a range of objectives, including improving agricultural and environmental outcomes, and empowering disadvantaged farmers such as women (Waddington et al., 2014).

Plant clinics have been known in the U.S.A. and other countries (Bentley et al., 2007). However, a whole network has emerged in countries of Central and South America, Asia and in Africa in countries like Uganda, Kenya, Rwanda, DR Congo, Sierra Leone, Ghana and Burkina Faso (Boa, 2007; Boa and Bentley, 2015) responding to the efforts of both governmental agencies and NGOs. Most of plant clinics have been supported by the Global Plant Clinic (GPC), an international service led by CABI in the UK (Boa, 2007). Plant clinics are public forums, often little more than a table and some chairs, that operate a few hours a week in a farmer-friendly location run by 'plant doctors'. The latter are local extension workers or farmers; its clients are all those interested in discovering the problems with their crops, and their best solution.

Plant clinics are the building blocks of a public plant health service, which in turn seeks to bring together extension and research, regulation and crop management under 'plant healthcare system' (Boa, 2007). As well as promoting good pest management, the low cost clinics provide farmers with expert advice on pests and diseases and mutually beneficial interaction with researchers (Boa, 2007). Plant clinics are excellent paths to bring farmers, extensionists and researchers together to tackle a disease problem impacting the farmers' livelihoods.

Côte d'Ivoire is the top African country that exports coconut oil from copra to West Africa and Europe (Arocha et al., 2017). Eighty five thousand smallholder farmers live on copra coconut oil in Grand-Lahou, one of the five major

national coconut growing areas, and home for 30.6 % of the coconut plantations of the country. The Ivorian coconut industry boosted during the 90's (ANADER, 2013) from an oil deficit in Nigeria and Ghana, and the decimation of the coconut grove in Ghana due to a lethal yellowing (LY) disease known as Cape St. Paul Wilt (CSPW). During the last ten years there were suspicions of LY occurring in Grand-Lahou, but it was not until 2013 that a phytoplasma, similar to the CSPW phytoplasma strain was associated with the Côte d'Ivoire lethal yellowing (CILY) disease (Arocha et al., 2017). Since then, 400 hectares have been wiped out, representing a loss of 12,000 tons of copra/year, and over 7,000 are under a severe threat.

Although both men and women farmers contribute in marketing and labor for coconut production in Grand-lahou, coconut farming is considered a "man's work". Men are responsible for land clearing and preparation and for harvesting, while women are in charge of weeding, transplanting, selling and copra processing (ANADER, 2013). Most of female farmers rely on male labourers for field preparation giving away 1/3 of the harvesting and keeping 2/3 for their families. Women's responsibilities also include cleaning the house, cooking, keeping up the courtyard, education children, and taking care of the family most of the time without electricity or running water, making it more onerous for women to earn a living (ANADER, 2013). Women's role within the coconut production chain is very undervalued and is constrained by limited access to resources, services and market opportunities. Interventions towards empowering women are imperative to address gender inequity, and to improve coconut productivity in Grand-Lahou.

The present work describes the process in establishing and organizing field schools, plant clinics, Women Coconut Fairs and Women Groups in CILY-affected villages of Grand-Lahou. Such events pursue to train, and inform farmers, stakeholders and policy makers to help improving disease management, income and nutrition sources, aim at alleviating the impact of CILY on the livelihood of the coconut smallholder farming community. A preliminary socio-economic characterization of the coconut-growing villages reveals the major constraints, and the main gender issues associated with the coconut production chain. Data and results show the impact of these events in improving the perspectives of farmers and stakeholders, specially women on CILY and its control; to address gender issues associated with the coconut production chain, and to find alternatives to revive the coconut industry in Grand-Lahou.

## MATERIALS AND METHODS

### Area of Study

Grand-Lahou is a coastal town in the southern Cote d'Ivoire. This is the seat of the Grand-Lahou Department

**Table 1.** Number of coconut producers and processors identified in Grand-Lahou.

Extension Center	Village	Producers		Processors	Total
		Male	Female	Female	
Lahou Pkanda	Braffedon	32	9	0	41
	Ablam	5	1	0	6
	Lahou Pkanda	59	5	1	64
	Legrekon	3	0	0	3
	Groguida	32	3	1	36
	Likpilassié	20	2	0	22
	Palmindustrie V1	27	1	2	30
	<b>Subtotal</b>	<b>178</b>	<b>21</b>	<b>6</b>	<b>206</b>
Badadon	Adjadon	6	5	0	11
	Dibou	11	3	0	14
	Badadon	52	13	0	65
	Doudougbazou	14	0	0	14
	Palmindustrie V2	26	0	0	26
	Tioko	8	0	0	8
	Tiokotchi	4	0	0	4
	Gbata	2	0	0	2
	Kpoklotchom	1	0	0	1
	<b>Subtotal</b>	<b>124</b>	<b>21</b>	<b>0</b>	<b>145</b>
Yaokro	Gredjiberi	8	3	0	11
	Kokou	14	3	0	17
	Palmindustrie V3	19	0	15	34
	Amanikro	4	0	3	7
	Yaokro	11	2	1	13
	Gbapo	2	0	0	2
	Liboli	16	0	0	16
	Makey	12	1	0	13
<b>Subtotal</b>	<b>86</b>	<b>9</b>	<b>19</b>	<b>114</b>	
<b>Total</b>		<b>388</b>	<b>51</b>	<b>25</b>	<b>464</b>

in Grands-Ponts Region, Lagunes District, situated where the Bandama River meets the Gulf of Guinea with GPS coordinates as 5° 8'11.72" N 5°, 1' 33.773"W. Twenty four villages including three of the extension centres located in the villages of Lahou-Kpanda, Badadon and Yaokro in Grand-Lahou (Table 1) were surveyed to identify the major constraints, and the main gender issues related to the coconut production in Grand-Lahou, as well as to select those villages to establish the field schools and run plant clinics.

### Surveys

Sex-dissaggregated surveys and information meetings were conducted from February to September in 2015, and 2016 in the 24 coconut-growing villages (Table 1) to assess for farmers' perspectives in establishing field schools and perform plant clinics, and to register farmers for these events. Well-designed questionnaires and in-depth interviews were used to interview men and women farmers in two different groups: one for producers, and

one for processors, and to collect data based on gender-sensitive indicators. Data collected was also used to identify the major constraints and gender issues faced by the coconut men and women farmers, producers and processors in Grand-Lahou.

### CILY Field schools

Data from surveys and information meetings was used to design training modules for field schools to cover farmer's needs, and to select reference villages to establish field schools, to set up coconut farms as demonstration plots, and to identify potential female and male trainees and trainers for future local field schools. For each field school the teaching schedule, training modules' strategy and designation of farmer trainers were customizely defined.

### CILY Plant Clinics

Small groups of 'plant doctors' formed by at least two natural scientists (plant pathologist, entomologist) and

one sociologist were organized to lead the plant clinics in each village. Two types of questionnaires were used to interview farmers and villagers (Boa and Bentley, 2015). The first questionnaire was focused on the site details to record information on the topic, location, GPS coordinates, type of audience, number of male and female participants, village of residence, information/promotion material used, and difficulties/highlights found while running the event (Annex 1). The second questionnaire was focused on the farmer interviewed to record information on the number of farms and coconut trees owned, gender, age, village of residence, knowledge on CILY, usage of the coconut crop, use of chemicals, willingness to learn on CILY, enquiries on non-coconut crops, and awareness of plant clinics (Annex 2).

Prescription forms (Boa and Bentley, 2015) (Annex 3) were used to record the possible cause of the disease problem per crop, and the corresponding management recommendations to the farmer interviewed, when applicable. A pilot survey to 41 Ivoirians and non-Ivoirians, including producers and other villagers attending the plant clinics was conducted in 5 villages to assess the acceptance of the plant clinics and the willingness to pay for the consultation services made by the plant doctors.

## RESULTS

### Major constraints associated with the coconut production chain in Grand-Lahou

The number and distribution of coconut producers and processors in Grand-Lahou were documented (Table 1). A total of 388 male and 51 female producers, and 25 female processors were identified from the analysis of data collected. No male processors were identified, which proves that copra processing is an activity dominated by women in the region of Grand-Lahou. Only one trader was identified in the village of Palmindustrie V1.

The major constraints related to the coconut production chain in Grand-Lahou were identified and classified in two different groups: **Group 1**, production-related constraints, and **Group 2**, marketing-related constraints. Group 1 included poor agronomic knowledge on the coconut crop; poor knowledge on CILY and the CILY phytoplasma; poor access to high-quality seednuts and planting material; scarcity of arable lands; lack of manpower and labor; lack of organization of stakeholders (male and female producers, processors). Group 2 included none or poor access to markets for selling coconut products; and poor knowledge on the diversity of coconut-derived products to commercialize. The

classification of the major constraints groups related to the coconut production in Grand-Lahou set the basis for the design of training modules for the farmer field schools responding to the major coconut farmer's needs.

### Gender issues associated with the coconut production chain in Grand-Lahou

Men are the main owners of coconut farms in Grand-Lahou, while for women, inheritance is the main way of land acquisition, especially from their late husbands. Women are denied access and control over farmland, and work at their husband's plantations (ANADER, 2013). Coconut producers have rights to land exclusion, transfer, penetration, alienation, collection, access and exploitation. However, women have only right to "use the land allocated by another person", which is an actual barrier to their participation within the coconut production chain (UNA, 2015). In addition, the coconut plantations that women can access are mostly weedy and non-productive plots, besides the high costs of farm labor, making their plots very prone to CILY infection.

On the other hand, women farmers in Grand-Lahou have poor access to agricultural innovations such as coconut processing or land preparation equipment, and quality seed or new varieties. Both men and women face other obstacles such as the poor road conditions, the geographical isolation of the villages, and the lack of reliable means to transport their produce from the farm to the village, especially during the rainy season.

Farmers have to walk long distances, or use a bike to be able to sell their produce, which are not the best means for elder people neither are available for all the families. For farmers to access the Grand-Lahou centre ville, they should use the ferry, canoe or boats to cross the lagoon Tiagba that divides the Grand-Lahou village area from the main land. The ferry is the fastest round-trip and takes around 30 minutes. In addition, producers and processors are not organized, which has negatively impacted the women capacity for buying/selling and marketing their coconut products.

### Field Schools

CILY awareness meetings allowed farmers, producers, processors and stakeholders to state their needs and concerns related to CILY, and to officially register for the field schools. Based on the major constraints associated with the coconut production that were identified, seven training modules were designed for the field schools (Table 2). Five modules were assigned for **Group 1** (production-related constraints), and two for **Group 2** (marketing-related constraints). Ten field schools were established in eight villages of Grand-Lahou for a total

**Table 2.** Training modules designed for field schools in Grand-Lahou.

Themes	Training Modules	
Production	Module 1	Coconut crop and farming: coconut biology, coconut quality nursery and seed, coconut planting techniques.
	Module 2	Coconut seed quality.
	Module 3	Coconut cultural practices: establishment of a nursery; planting techniques.
	Module 4	Plant and Environment Protection: fight against bushfire; disease and pest control (CILY); alternative hosts for the CILY phytoplasma.
	Module 5	Establishing plantations.
Marketing	Module 1	Organization of coconut producers.
	Module 2	Marketing techniques: market research, sell/buy, price setting.

**Fig 1.** Field School held at Badadon village showing a training session to the Effozoui Assia Women Group.

area of 1086.5 ha, which included Braffedon, Badadon (Fig 1), Yaokro, Lahou Kpanda, Likpilassié, Doudougbazou, Gredjigberi and Palmindustrie V1. Each field school was structured with one class leader, one reviewer and one secretary that received special training (UNA, 2015), and are now able to teach other farmers. All field schools were established on men-owned plantations. Women-owned plantations were generally remotely distant from the villages, most of them in small areas with a very difficult access. Nevertheless, 244 men and 36 (12.8 %) women farmers attended the field schools for a total of 280 participants per module. A total of 1960 farmers (1568 men, 392 women) were trained, including 107 extensionists, who will be able to train other farmers. It is noteworthy, the increasing interest from the villagers, specially youngsters in working for the coconut

sector, and extend the field schools to other CILY-free villages to raise disease awareness.

As part of the field schools, women farmers received a training on coconut land preparation. This module was highly accepted as women farmers acquired the knowledge to deal with the basics of the coconut crop and farming. Training on Modules 2, 3 and 4 allowed farmers to recognize the CILY symptoms in the field; how to manage CILY-affected palms to communicate the status of their farm regarding CILY, to properly apply the field disease management strategies, and how to establish coconut nurseries for their own seed supply.

One of the main outcomes of the field schools was the development of a farmer field mini-guide that was distributed among farmers. The 9-pages 8x8 cm field mini-guide includes high quality color photos and a

**Table 3.** Plant clinics held in coconut-growing villages of Grand-Lahou.

Villages	No. of attendees			Date	Query Crops
	Men	Women	Total		
Badadon	109	48	157	04/03/2015	Coconut, eggplant, avocado, yam, cocoa, maize, cassava, pepper, tomato.
Yaokro	54	3	57	18/06/2015	Coconut, avocado, plantain, orange, coffee eggplant, pepper, okra, groundnut, cocoa, maize
Palminindustrie V1	101	42	143	06/08/2015	Coconut, pepper, okra, eggplant, cola tree, avocado, mango, maize, coffee, groundnut, banana, grapefruit.
Likpilassié	26	5	31	13/11/2015	Mango, banana, eggplant, coconut
Braffedon	25	10	35	27/01/2016	Coconut, maize, banana, eggplant, pepper, okra, sugar can, cocoa, cassava, guava, avocado, mango.
Braffedon	87	53	140	20/04/2016	Pepper, eggplant, guava, cassava, sugarcane, avocado, okra, coconut, cocoa, banana, mango
Liboli	16	4	20	20/05/2016	Coconut, cassava, eggplant, cocoa
Palminindustrie V2	40	20	60	19/08/2016	Coconut, cocoa, avocado, tomato, eggplant, pepper, banana, cassava.
Toukouzou	8	2	10	30/08/2016	Lettuce, pepper, eggplant, cassava, coconut
Tiapoum	12	6	18	22/09/2016	Eggplant, cassava, okra, tomato, maize, banana, palm, cocoa, taro.
<b>Total</b>	<b>478</b>	<b>193</b>	<b>671</b>		

summarized step-by-step description in farmer's language to assist them in symptom and CILY disease stage recognition, as well as, in the implementation of the new disease management plan specifically developed for CILY in Grand-Lahou.

Another important outcome of the field schools was the creation of six Women Groups in six villages of Grand-Lahou. With a total of 173 registered members, the villages include Binkadi in Palminindustrie V1 (30 members), Solidarity in Palminindustrie V3 (30 members), Club Victorie in Palminindustrie V2 (30 members), Ebo Ebo in Yaokro (30 members), Union in Doudougbazou (25 members), and Effozoui Assia in Badadon (28 members). Women Groups currently enable women to access customized training on land preparation for coconut farming. Women Groups have established in each village, 2 ha of cassava yards in farms in areas decimated by CILY. These cassava yards are an alternative food and cash crop to cover the losses of coconut palms due to CILY. They have become a new initiative to support crop diversification and to empower women farmers to become independent and enable them to improve their family's nutrition and income.

### Plant Clinics

Ten plant clinics were held in nine villages: Badadon, Braffedon, Yaokro (Fig 2), Palminindustrie V1, Palminindustrie V2, Likpilassié, Liboli, Toukouzou,

Tiapoum have attracted 671 attendees including 474 villagers (478 men, 193 women), and scored 240 queries on CILY and diseases of other 22 crops such as cassava, yam, cocoa, coffee, avocado, maize, etc (Table 3). Two of the plant clinics were run outside the Grand-Lahou Department in the villages of Toukouzou (Jacquesville) and Tiapoum (Aboisso), the latter in the Eastern, close to Ghana, where no disease is present.

All farmers interviewed grew coconut palms for their families as the main income source. Over 80% of the interviewees had CILY in their farms; around 65 % had not heard about CILY before attending the plant clinics. It is noteworthy that 76 % of the farmers that attended the plant clinic, confirmed to have CILY in their farms.

A pilot survey was conducted in 5 out of ten plant clinics: Badadon, Lipkilassié, Yaokro, Palminindustrie V1 and Liboli. From the 41 farmers and producers surveyed, 78.04 % corresponded to Ivoirians and 21.95 % to non-Ivoirians. Both groups acknowledged the critical role of plant clinics for raising disease awareness, and the usefulness of advice and recommendations from plant doctors, as well as the need to continue with the plant clinics on behalf of the farmers and producers, and to extend them to other villages of Grand-Lahou and outside.

Thirty two queries were made on CILY, 12 on coconut crop, 12 on cacao, and the rest on eggplant, cassava (manioc), banana, maize, coffee, and avocado. Plant doctors provided disease management recommendations

**Fig 2.** Dr. Kra (plant pathologist) and Dr. Kwadjo (entomologist) leading a plant clinic held at Yaokro village.



based on environmentally-friendly field practices since farmers in Grand-Lahou avoid chemical use for disease control in their farms. Twenty out of 41 producers that followed the plant doctor's recommendations stated that their attendance to the plant clinics was driven by the high level of confidence on the plant doctors, and the positive impact of their recommendations in saving their crop production.

Over 70 % of the surveyed farmers and producers demanded to establish an official permanent plant clinic office in each village that can be consulted anytime and enable them to follow-up recommendations, and to extend the initiative to other villages. Farmers also requested that every plant clinic provides them with crop protection and training among beneficiaries. Villagers and producers expressed their willingness to pay a maximum of 5000 FCFA (corresponding to \$8 USD) and a minimum of 500 FCFA (\$0.75) to each plant doctor per consultation. Young producers and villagers stated that becoming a plant doctor will represent for them having a job right at the village providing them with extra income, so they will be able to better help their families without having to migrate to the city.

### Women Coconut Fairs

Eight Women Coconut Fairs were organized in six villages of Grand-Lahou during 2015 and 2016 with a total of 550 participants (390 men and 160 women).

Women farmers displayed and sold hand-made coconut products, which ranged from crafted products, cosmetics to home furniture. The range of coconut products displayed and sold by women increased from 14 to 26 (64 %) from 2015 to 2016 (Table 4). Coconut products included crafted items, coconut charcoal, coconut-based fish food, copra, coconut milk, and coconut firewood, coconut leaf planks, coconut-based mosquito repellent, etc. Approximately 20 % of women sold hand-made coconut cakes that became highly popular, and allowed them to start-up their small coconut businesses within the village area and Abidjan.

### DISCUSSION

Land acquisition is one of the main issues that affect women within the coconut value chain in Grand-Lahou. In fact, land acquisition is a well-known gender problem in the African continent, particularly for women (McCallin et al., 2009; Spichiger et al., 2013). In 1998, with assistance from the World Bank, Côte d'Ivoire adopted the Rural Land Law to transform customary land rights into private property rights regulated by the state (McCallin et al., 2009). This law reverses traditional practices with respect to women and land, granting them rights equal to those of men. However, due to the lack of resources and the political turmoil from 1999 to 2011, the law remains very little known and therefore not fully implemented.

**Table 4.** Coconut products displayed and sold by women farmers in the Coconut Fairs.

Villages	Coconut Products	Participants des villages			Date
		Men	Women	Total	
Badadon	Flower pots, tables, lamp base, cooking utensils, crafted jewelry (earrings, bracelets), sweetened grilled coconut, cake, toffee, coconut oil soap, crafted items (ice container, jewelry box), trays, toothpicks holders, coconut-based home furniture.	92	35	127	04/03/2015
Palminindustrie V1	Mats made of coconut leaves, coconut oil, broom, coconut milk-based pudding, fried rice cooked with coconut oil, coconut cake, sweetened grilled coconut, coconut oil soap.	53	57	110	12/11/2015
Doudougbazou	Coconut oil, broom, coconut cake, coconut oil base soap, sweetened grilled coconut, toffee, biscuits.	52	18	70	28/01/2016
Liboli	Flower pots, crafted items (cups, jewelry box), chairs, coconut oil, coconut broom, sweetened grilled coconut, coconut cake, toffee.	30	13	43	20/05/2016
Palminindustrie V3	Coconut oil, broom, sweetened grilled coconut, coconut cake, toffee.	48	10	58	18/08/2016
Tiapoum	Coconut wood rafters, coconut wood planks; firewood, coconut oil-based mosquito repellent; coconut fish food, charcoal, broom, coconut oil, copra, coconut water; seednuts, coconut milk, sweetened grilled coconut, grated fresh coconut, toffee, coconut cake, coconut oil soap, crafted jewelry.	59	7	66	21/09/2016
Braffedon	Coconut milk porridge, broom; maize meal with coconut oil; coconut cake, coconut oil; toffee, sweetened grilled coconut; coconut oil soap, fresh coconut.	30	8	38	18/08/2016
Yaou	Broom ; coconut cake, coconut oil, sweetened grilled coconut, coconut oil soap, fresh coconut, best coconut A, B and C, coco glace, palisade with coconut tree palm, firewood.	26	12	38	19/11/2016
<b>TOTAL</b>		<b>390</b>	<b>160</b>	<b>560</b>	

On the other hand, the impact of poor road conditions and inadequate or none transportation in the access to education, health services and markets as for the case of Grand-Lahou is well documented throughout the sub-Saharan countries (Porter, 2007). Such impacts on women and their daughters are particularly severe because of stronger constraints on female mobility. Therefore, interventions are required to mitigate the negative effects of long distance and time spent travelling to major markets and other services by women. The implementation of low-cost, regular and reliable transport services, or increase availability of bicycles and motorcycles is recommended (Porter, 2007).

Any intervention in changing attitudes regarding women's empowerment requires raising awareness and cultural change, which demands multi-faceted and coordinated approaches (Al-Zubaidi et al., 2013). For instance, the Ethiopian government introduced land title certification in 2003 with land titles issued in the joint names of spouses, so their both land rights are recognised and

documented. In Rwanda, the land rights of both women and men are recognised by law and can now be registered (Girma and Giovarelli, 2013). In northern Ghana, Uganda and Zambia, grassroots organisations have successfully mobilised women in to cooperatives/groups, providing training, and also raising awareness of women's land rights at the community level (Spigher et al., 2013). These interventions helped women to access land and enjoy relatively secure tenure. In Côte d'Ivoire, there is still a long way to go to make the necessary change that will empower women farmers with regards to transportation means or land ownership. Therefore, gender-responsive participatory approaches and interventions have to be implemented to trigger the mechanism that will lead to successfully achieve such a change. Field schools and plant clinics have been the most timely and feasible approaches developed in the last two years, appealing to farmers, stakeholders and policy makers, and with the potential to start up the engine to initiate the steps to pave the way to the change.



Farmer field schools are an alternative participatory extension approach proven to address some of the emerging needs for farmers, and provides them with a platform to meet regularly in groups to study the 'how and why' of farming (Duveskog, 2013). In Mozambique, field schools were used to establish test plots for cassava improved varieties to help improving food security. In Tanzania, in the Unguja District, field schools have been the approach to teach farmers a more effective way to produce milk, which increased from 1-3 L per cow per day to 16 L. Moreover, in the Kisongoni District, over 20,000 farmers were trained on seed selection, harvesting and weeding, and they are now producing their own seeds with a guaranteed sales to farms (Duveskog, 2013).

Previous surveys performed in Grand-Lahou (Mahyao et al., 2016) urged interventions to address the very low literacy level of coconut farmers in Grand-Lahou (over 89 % regardless the presence or absence of the disease), and to develop training and education approaches, particularly to empower women coconut farmers in aspects such as disease recognition in the field, farming, and marketing and commercialization. The fast adoption of the field schools in Grand-Lahou has indeed provided farmers with the basic skills and training on coconut farming, field practices to better manage CILY, and marketing platforms such as the Women Coconut Fairs to collectively contribute to prevent disease spread, and improve family income and nutrition.

Farmers learned very quickly the importance of crop diversification and the advantages of intercropping coconut with other food or cash crops such as maize and banana as alternative income and food sources, and particularly for women, the cassava yards. Women Groups enabled women farmers of the coconut sector to organize themselves for the very first time in Grand-Lahou, and find an alternative to have extra income and a food source to support the family wellbeing. In addition, women coconut farmers gained new skills on how to find new niches for commercialization and marketing of their coconut products and also to identify new niches for small private businesses.

Plant clinics were held not only in villages of the Grand-Lahou Department, but also in free-disease areas such as Aboisso, close to Ghana, as well as in the Jacquesville region. This means that farmers and stakeholders have a good understanding of the impact of extension in raising awareness even in disease-free villages in order to prevent disease spread. Plant clinics revealed that although CILY was the most common problem, yet farmers also brought other diseased plants grown within and in the periphery of the coconut plantations. This showed that farmers seek more information on CILY and other diseases affecting their

alternative cash or food crops. Plant Clinics have proven to be the most powerful and feasible tool to gather all the needed information from farmers.

Sex-dissaggregated approaches were crucial to collect data that help to precisely identify approaches to address gender issues related to the coconut production in Grand-Lahou, to spot other plant disease problems and to access to proper management recommendations. It is noteworthy that young villagers and producers foresee the plant doctor job as a potential income source, and a practical approach to directly help their villages to fight disease problems and increase food security.

Plant Clinics showed to be a suitable approach to engage policy and decision makers. One example is the plant clinic held at Braffedon in April 2016, which was attended by the Canadian Ambassador in Côte d'Ivoire, a Representative of the Ministry of High Education and Scientific Research, and the Prefect and Major of Grand-Lahou. Policy makers and authorities were able to engage in the activities implemented for the dissemination of the new CILY management plan such as farmers's interviews, delivery of flyers, and the use of mobile microscopes to observe insects. Similarly, plant clinics held in Uganda, Tanzania, Ethiopia and Kenya were the key approach to raise awareness on the Napier Grass Stunt phytoplasma, and the implementation of new field practices such as the push-pull technology to control stem borer and striga of maize (Murage et al., 2015).

Boa et al. (2016) estimated the costs of a plant clinic if all basic equipment needs to be purchased, which would be around US\$300, including transportation, daily allowances, internet connections and airtime for mobile phones. Sustainability of plant clinics depends on organisations incorporating them into their everyday activities and embedding them in a plant health system; hence local commitment plus strategic national support is the key to maintaining regular and high-quality services (Boa et al., 2016).

Although no expense estimates have been done for the field schools in Grand-Lahou, costs around the world range from as little as \$30 USD to as high as \$3,000 USD depending on the duration and nature of the field school, as well as people involved. Field schools and plant clinics, and the major outcomes, Women Coconut Fairs and Women Groups are expected to be extended to other coconut-growing villages, even where CILY is not present. The extent aims at raising CILY awareness to prevent disease spread into CILY-free areas; identifying new disease problems in other food and cash crops; and promoting crop diversification and approaches to address gender inequalities within the coconut value chain. This has already started with the plant clinics held in Toukouzou (Jacquesville) and Tiapoum (Aboisso). Field schools and plant clinics may also become the strategic

pathways to promote women land rights and to implement low-cost local transportation interventions in Grand-Lahou.

## CONCLUSIONS

Field schools and plant clinics have proven to be effective participatory approaches for agricultural extension, education, and training, particularly for women coconut farmers in Grand-Lahou to fight CILY. Those have been also powerful tools to engage not only farmers and stakeholders, but also policy and decision makers in raising CILY awareness, adopting new disease management strategies, and empowering women. Advantages should be taken from these avenues to put in place sound informing policies, and gender-responsive ways to effectively address the major constraints and main gender issues related to the coconut production chain not only in the Grand-Lahou south coastal littoral, but also throughout Côte d'Ivoire and West African countries where lethal yellowing diseases are seriously impacting their coconut industries.

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