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Education in Agroforestry: Developing an educative program by integrating local experiences in the Dominican Republic and international knowledge about agroforestry of cocoa

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Abstract

For decades the development of educational curriculum for higher institutions (universities) has been done by a few people specialized in the subject, however this way of developing the curriculum has been criticized for being a top-down strategy that does not take into account the needs of the student, job opportunity, social, environmental and economical aspects of the society, the industry or companies that hire them and in general the interested parties within the educational program (Freire 2008; Rudebjer & Del Castillo 2001). It is also mentioned that agroforestry/forestry curricula lack functionality when curricula are not updated or adapted to the changing society; demand of the sector and technologies (Piñeros 2021). This is also the case of agroforestry education in the Dominican Republic, which is considered to have a system of low educational performance with a real potential of improvement (Gajardo 2007). Having in mind that agroforestry is a dynamic subject that is used by small scale & family farmers where complex systems are managed in an integrated way (Temu 2010), then a participatory approach will be ideal for developing an educational program in agroforestry of cocoa.

This thesis describes the process of developing an educational curriculum (*diplomado*) in agroforestry of cocoa with the application of tools of participatory approach (interviews, focus meetings) within its methodology. First, agroforestry programs were analyzed from international knowledge (universities and practitioners) to find where, what and how they teach the subject of agroforestry. Then local programs available in the Dominican Republic were analyzed to see if classes could be adjusted to build a Diplomado, an applied course delivered by University. Innovative elements from international and local programs such as educational tools, subjects, skills, etc. of the programs were incorporated into interviews, conducted with 54 people from five different stakeholders groups. Quantitative and qualitative data were analyzed with thematic analysis coding (Gery & Russell 2003).

The findings of this thesis show that incorporating local/ international knowledge and merging different views from stakeholders enriches the development of an educational program. Moreover, a methodology for the Diplomado is proposed thinking on the skills and goals of the program.

This curriculum is flexible, multidisciplinary and aims to be inclusive with the participants by using different ways of learning, and applying active learning/ teaching methodologies

Keywords

Agroforestry, farming systems, education in agroforestry, participatory approach, curriculum development, active learning, active teaching

Resumen

Durante décadas el desarrollo del currículo educativo para las instituciones superiores (universidades) ha sido realizado por unas pocas personas especializadas en el tema, sin embargo esta forma de desarrollar el currículo ha sido criticada por ser una estrategia de arriba hacia abajo que no toma en cuenta las necesidades del estudiante, la disponibilidad de empleos, la industria o empresas que los contratan y en general las partes interesadas dentro del programa educativo (Freire 1970, 2021; Rudebjer & Del Castillo 1999, 2001). También se menciona que los currículos agroforestales/forestales carecen de funcionalidad cuando no se actualizan o adaptan a los cambios de la sociedad, la demanda del sector y las tecnologías (Piñeros 2021). Este es también el caso de la educación agroforestal en la República Dominicana, que se considera que tiene un sistema de bajo rendimiento educativo y está en proceso de mejora (XX). Teniendo en cuenta que la agroforestería es un tema dinámico que es utilizado por los pequeños agricultores donde se manejan sistemas complejos de manera integrada (Temu 2010)

Esta tesis describe el proceso de desarrollo de un currículo educativo (diplomado) en agroforestería del cacao con la aplicación de algunas herramientas de enfoque participativo (entrevistas, reuniones focales) dentro de su metodología. Primero se analizaron los programas agroforestales de las universidades internacionales para encontrar dónde, qué y cómo enseñan la materia de agroforestería. Luego se analizaron los programas locales disponibles en la República Dominicana para ver si las clases podían ser ajustadas para el Diplomado. Se incorporaron en un cuestionario los elementos innovadores de los programas internacionales y locales, tales como las herramientas educativas, las materias, las habilidades, etc. de los programas. Se realizaron entrevistas con 54 personas de cinco grupos interesados

Los resultados de esta tesis demuestran que la incorporación de conocimientos locales e internacionales y la fusión de diferentes puntos de vista de las partes interesadas enriquecen el desarrollo de un programa educativo. Además, se propone una metodología para el Diplomado pensando en las competencias y objetivos del programa.

Este plan de estudios es flexible, multidisciplinar y pretende ser inclusivo con los participantes utilizando diferentes formas de aprendizaje, y aplicando metodologías activas de aprendizaje/enseñanza

Palabras clave

Agroforestería, sistemas agrícolas, educación en agroforestería, enfoque participativo, desarrollo de planes de estudio, educación activa, aprendizaje activo

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Abbreviations

AFS: Agroforestry systems

LAC: Latin America and Caribbean

DR: Dominican Republic

UNEV: Universidad Evangélica

UASD: Universidad Autónoma de Santo Domingo

UAFAM: Universidad Agroforestal Fernando Arturo de Merino

ISA: Instituto Superior de Agricultura

FFS: Farm field schools

D.R.: Dominican Republic

PCD: Participatory Curriculum Development

TNA: Training needs assessment

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1. Introduction

1.1 Background

This thesis is part of the Cacao Forest Project for Phase II 2019-2023 (www.cacaoforest.org). The general objective of this phase is to promote the implementation of good practices in agroforestry systems in the cacao production in the Dominican Republic, to increase the quality and productivity of the cacao and to improve farm revenue and their resilience by uses and process of fruits, plants and others from the agroforestry system. Consequently, this will improve farmers' livelihood and protect the environment (Cacao Forest, 2022). As part of their objectives, *Section 4* aims to contribute to the transformation of the national vision of the cacao production in the Dominican Republic. Within this objective (*4.3 section*) aims to "Integrate Agroecology and Agroforestry in higher education in the Dominican Republic '' and it is from this component that this thesis was based on. Previous study was done by Ernesto Hernandez- (Isara Msc Student, 2021) where he concluded that a Diplomado in agroforestry of cocoa will be the most logical approach to incorporate agroforestry training in universities (Hernandez 2019). This Diplomado is already defined as a short course (around 10 weeks) set up by Dominican Universities delivering basic and applied knowledge for students (and potentially practitioners i.e technicians, young farmers)

Moreover, agroforestry/forest education may address pressing needs to solve such as deforestation, forest degradation, conserving biodiversity and protecting ecosystems, improving livelihood, and mitigating global warming (Piñeros 2021).

1.2 Problem Description and Opportunities

1.2.1 Social Aspects

An important social aspect which influences cocoa production worldwide is the aging of cocoa farmers (Ruf, 2014). In the Dominican Republic, the mean age for cocoa producers is 58 years old and the average household size is 4 (Berlan and Berges 2013) while the younger generation tend to leave rural areas for major cities or touristic areas. In fact, in the country's main cocoa-producing region (North East), only 60% of producers report that the renewal of farming by the next generation is assured (Mattalia, 2016).

Moreover, agroforestry of cacao owned by small scale farmers is the essence of the Dominican Republic's cacao production becoming one of the main world exporters of organic cacao from agroforestry systems (IICA 2020). Cacao grown in AFS is also the way of life for rural communities in the Dominican Republic which has socio-economic problems such as food insecurity and dependency on the vulnerability and volatilities of the cocoa price (Tothmihaly 2017). However, the jobs in agriculture in the D.R. have declined from 18% in 1999 to 9% in 2019 (World Bank 2019) which could be explained with high growth in other economic sectors such as tourism, construction, and mining but poverty rates are persistently high in rural areas and women face disproportionate challenges throughout the country (World Bank, 2022). Therefore, creating jobs in AFS and involving young and educated people in the agricultural sector is key for the continuation of cocoa farming in AFS.

1.2.2 Labor employed on the farm and gender issues

According to FAO small farms utilize family labor and occasionally employ 1-2 people for harvesting season (FAO 2001). Moreover, sixty percent of the labor is Haitian migrants in small farms in extreme poor conditions (FAO 2001); Despite, specific and recent studies are unknown about haitian work in the cocoa sector but it is visible when visiting a farm in the DR. There are an estimated 800,000 Haitians living and working in the Dominican Republic in the agriculture and non-agricultural sector (Simmons 2010) where many young people leave rural areas.

All around the world, women have a significant impact on the agricultural and rural economies (FAO 2011). Currently, in Latin American and the Caribbean, females are mostly hired by the service sector and only 4% of employment in the agricultural sector (FAO 2011).

In the D.R. a patriarchal system prevails in all areas of the society including the rural households where, historically, cocoa farming has been a male predominant activity and males are recognized as the breadwinner and authority figure while females stay at home and contribute with family farming tasks such as processing, harvesting and house chores (Raynolds 2002).

Therefore, the involvement of women from the farm in cocoa processing is still limited or perhaps unacknowledged or invisible. Moreover, agrarian policies that grant credit, land and other resources have increased the gender inequalities in the farm households. In fact, out of 88.000 parcels distributed by the Dominican agrarian reform program only 7 000 have gone to women (Raynolds 2002; MUDE 1996)

The problem and opportunity of the gender gap has been talked about in the International Conference of Cocoa (2016) where ICCO put this issue on the table and some changes were made such as equitable pay in the cocoa industry in the DR (Fadika 2016). However, providing access to education for females and underserved groups (Haitian migrants) could be a determining factor for them to be included in cocoa AFS.

1.2.3 Land and Tree Tenure

Land and tree tenure rights is an important factor for small farmers to adopt AFS and sustainable practices (Place, 2009, Neef and Heidhues, 1994, Nkomoki et al., 2018). Therefore, it is important to know about land tenure in the D.R. Inadequate policies exacerbated the land and tree situation; In 1910, farmers had to get permission before clearing their land (Geilfus 1998). During the dictatorship of Trujillo (1930-1961) , land was owned by the government and concentrated in few hands, people were displaced to nearby lands that were less productive (Geilfus 1998; Luna 1984). But after the dictatorship landless people moved to the land and claimed the land by cutting the remaining trees. By 1967, a strict forest legislation was placed (Logging ban) which was enforced by military-led Forestry Service where foresters became a symbol of oppression for the farmers since farmers could go to jail if they cut the trees. Therefore, farm land with trees was considered a future distress (Geilfus 1998, Brothers 1997, Hartshorn et al. 1981) inducing regular deforestation in DR.

Currently, there is lack of control and registration about land use in the DR which complicates the situation for farmers. Inheritance tax has a high cost therefore, people tend to not legalize their property titles; only 47% of the agricultural land is owned by farmers with a property title. This has limited the capacity of the farmer to acquire credits (Batista 2009)

1.2.4 Traditional and Local Knowledge

Traditional and local knowledge includes dynamic and complex bodies of know-how, practices and skills that have been developed and maintained by communities. Informal knowledge is fundamental to contemporary small-scale farming in the Caribbean since it has helped communities to adapt, survive and prosper in different situations (Beckford and Barker, 2007). In the DR, farm families have developed several projects based on community agroforestry and silviculture which has also helped change the national forestry policies (Sibelet et al 2021). For instance, in the Northeast of the D.R. farmers start to reforest the land with *Acacia mangium* and develop diverse cropping systems such as alley cropping,*conucos* (small annual crop plots), fallow, intensive agroforestry, and homegardens (Sibelet et al 2021; Valerio and Robineau 1992). Therefore, the agroforestry system of cocoa has been developed during the last 20 years when coffee production tends to decline. Notaro 2020, classifies 140 cocoa AFS with farmers management practices through farmers' interviews. However, there is no record of studies that have been focused on farmers' knowledge in cocoa AFS in the D.R. This could be important for the transfer of knowledge to next generations. Currently, farmers are perceived as harvesters of cocoa and not necessarily as agricultural entrepreneurs, changing people's perceptions about farmers could be achieved by incorporating farmers to informal and formal education.

1.3 Education in the DR

The Dominican Republic has been known to be one of the most unperforming educational systems due to large class size, early education high dropout rate, inadequate facilities, low quality of entrance to the teaching profession, inadequate teaching preparation, low admission standards, shortage of teachers, low teacher salaries and outdated curriculums (Hamm & Martinez, 2017 ; Manning, 2014) . In 2012, changes were made to the education reform and the allocation of money to public education increased from 2% to 4% of the GDP (OECD 2008), and other efforts have been made to improve education such as joining the Dakar conference in 2000 and signing the "Jomtien commitments", that affirms education as a fundamental right with good quality and inclusiveness (Gajardo, 2007). Then, the world bank invested in 2015 to assist the Dominican government in the educational reform by focusing on training teachers and assessing students in the different levels of education (Lipp, 2017). Despite all these efforts, the Dominican republic still ranks within the low income with low educational level in the region (Gajardo 2007). Moreover, the Minister of Education in 2015 published an ordinance; "the bases of a curriculum review and updates' 'where curriculum by competences is stated not only as cognitive skills and abilities but also as a complex set of motivations, emotions and affections (MINERD 2015). However, this is a long-term proposal and critics have mentioned the barriers to be overcome, such as the change of logistics (academic load, enrollment limits), and the resistance to change from a "traditional" educational system (Santana 2020).

Having this in mind and knowing that the development of agroforestry curricula is also relatively recent in universities all over the world, and many current agroforestry curricula need to be revised because of constant changes in the practice (Rudebjer et al 2005). There is a global concern brought up in international conferences about inadequate, and declining forest education (Rodriguez 2021) where agroforestry systems should be protected in sensitive areas facing extreme climate events (Rossi, 2021).

Due to all of these reasons there is a lack of knowledge in agroforestry/forestry, lack of professionals qualified in this area, and graduates from these programs are not fully prepared to meet the changing demands (Rodriguez 2021).

A survey study done in Latin American countries by the FAO shows how respondents felt about different contents of the forestry educational programs. It is mentioned that topics related to planning and management of forests and trees (e.g. biodiversity, forest ecology, forestry, forest planning, sustainable use systems, watershed management, soils, forest products, conservation and forest health), were considered sufficiently covered. However, climate change, forest restoration, and agroforestry were insufficiently covered while other thematic groups such as forest services (extensionism), social and cultural aspects have been neglected in the region (Rodriguez 2021; Encino, 2004; Malleux, 2014). Moreover, the survey also reveals the lack of soft skills among forest professionals and students (Rodriguez 2021; Rekola et al.,2017). Finally, the participation of extra-curricular activities which enhance student learnings was moderate (Rodriguez 2021).

There are no specific studies about gaps in forestry/agroforestry education in the DR that have been done.

1.4 Economical Aspects

The production of cocoa in agroforestry systems brings revenue to the rural areas which reduces poverty by creating jobs, generates foreign exchange, contributes with food security and contributes with conservation of natural resources and the environment (Rodriguez 2019). There are an estimated 40.000 cocoa farmers in the DR with 16.5% producing organic cocoa (IICA).

The Dominican Republic leads the production of organic cocoa with 152,260 ha (Berlan and Berges 2013) and it has positioned itself as one of the main organic cocoa producers in the region and eight in the world (Rodriguez 2019). However, organic production is challenged by international price fluctuation, economic stability of farmers, strict regulations, high cost of certifications, lack of financial support, and lack of training. Moreover, within the cocoa value chain, benefits are very unequally distributed: large commercial companies and industry get 70% of the final price of the product and only 5% of the final price goes to the producers or farmers (Rios et al 2017). As mentioned by Berland and Berges 2013; “most cocoa farmers are vulnerable smallholders without financial resources or technical skills to intensify their practices”.

The majority of their income for cocoa AFS farmers comes from the production of cocoa (75%) but they also produce other crops that are for self-consumption or sold (Notaro 2020; Cerda 2014). In fact, cocoa in agroforestry systems are cultivated with numerous plant species (Deheuvels 2011; Deheuvels et al. 2012; Cerda et al. 2014; Abdulai et al. 2018; Suarez Salazar et al. 2018) which bring potential revenue to the farm but there is a lot of fruits and crops that are also wasted in the field, such is the case of breadfruit because there is lack of knowledge about their nutritional benefits and scarce commercialization (Polanco 2019).

Notaro (2020), noted the diverse crops of cocoa AFS that overall contributed with a global income of US$2404 ha-1 yr-1 on average with a real potential of growth if farmers and their cooperative could invest in process and market.

2. Research Questions, Objective, and limitations

The **objective** of this research is to identify and provide international research and local data collection to create a functional participatory curriculum for agroforestry education. Interviews to the stakeholders, and meetings with the educational committee, analyze the need for the Diplomado in agroforestry (Curriculum), define target audience, topics to be taught, skills to develop,etc and emphasized base on the local reality, and finally realized what educative methods will be suitable for the different audience. The aim is to define a curriculum of a highly specialized and multidisciplinary short academic training in agroforestry.

Three research questions have been raised :

RQ1 *How to integrate components of local knowledge and international knowledge to a participatory* curriculum development for Educative Program in Cocoa Agroforestry in the Dominican Republic

RQ2 *What topics are important to teach/learn in Cocoa Agroforestry for students/ farmers/technicians?*

RQ3 *What educational tools/ pedagogic strategies are currently used in Agroforestry in the DR? What educational tools can be created to facilitate teaching agroforestry with local information?*

There were **several limitations** to this study; This study was done in five months which is not enough time to do an extensive analysis having in mind that the culture of the Caribbean is laid back and things take time. There were limited resources available such as money and time to visit different people within different groups. Most of the farmers were interviewed in two sessions of Cocoa Forest workshops. Moreover, getting in contact with people and gaining their trust and creating rapport with people took time since I am not Dominican. However, this also gave me the benefit of the doubt and allowed me to ask questions that could give me more inside information. As a woman and Spanish speaking person, in a society that has strong patriarchal traditions, it was not easy to make connections for the interviews (LAB 2013). Moreover, there were certain constraints that didn't allow me to get in contact with some of the stakeholders that were important for this study such as researchers.

3. Methodology

Several steps were taken into consideration to develop the curriculum. Details can be found in Annex A

3.1 Literature Review

3.1.1 International Universities Literature Review

In an effort to comprehend and analyze agroforestry educative program focus, incorporate international knowledge and innovative materials into the curriculum a Web-based research was done through: "*FindAmaster"* website with the keywords *"Master Programs in Agroforestry"* and *"Certificates in Agroforestry"*. A list of Universities across the world that had those programs was mapped then individual research was done in school's websites for their objective and goals of the program, classes taught, duration, agro-ecological zone focus, educational tools used, mode of teaching (online or face/face), and target audience, this was recorded, quantified and analyzed in Excel .In some cases, emails were sent to the programs to get more information about them. Only programs that have been given by universities have been taken into account.

3.1.2 Curriculum Analysis from Universities in the Dominican Republic

In order to conceptualize the knowledge available and possible classes that could be adjusted for the "Diplomado in agroforestry of cocoa" a web-based research was done, and some universities were contacted for their pensum. This is also how universities were selected to help develop this Diplomado. There are three phases of analysis of possible classes for the program:

a) Overall analysis of the possible classes within a broad spectrum: undergrad and grad programs in Agronomic, Forestry Engineering, ecology & environmental management, Agroforestry Engineering, and plant protection (Annex B)
b) A narrower analysis was done with 5 programs in the Dominican Republic: "*Forestry and Agroforestry Engineering programs"* and a list of classes was created having in mind that agroforestry should include agriculture, environmental management, social and economical topics (Rudebjer 2005) (Annex C)
c) Objectives of those programs were categorized to understand the programs' tendencies per Universities and overall gaps - Gaps meaning lack of specific subject in the programs that could be fulfilled with international professors

3.2 Data Collection

3.2.1 Study Area

All interviews were done in the capital city of Santo Domingo (Universities), in San Francisco de Macorís, and Castillo located in the Duarte Province. The field word of this research was conducted in 2022 from April to July. San Francisco de Macoris and Castillo are in the Cibao Northeast region that has the most cacao producers, as well as the processing industries.

Characteristics of the cocoa growing areas in the DR: Temperature varies from 21C to 31C, Rainfall: 1500-2000 mm/year, well distributed from April-December (Batista 2009).

3.2.2 Stakeholder Analysis for the Educational Program

A stakeholder analysis, importance and influences as well as a participation matrix done in two meetings with Cacao Forest representatives. It was used as reference ; " A guide to learning agroforestry" by Rudebjer et al 2001.

3.3.3 Interviews and educative committee meetings

Paper Interviews were done with 54 people who represented a specific group of stakeholders within the production of cacao in agroforestry systems in the Dominican Republic. Semi- structured interviews with close a and open-ended questions were applied based on the previous content/study suggested by Ernesto Hernandez-(2021) where modules were pre- selected. The interview lasted an average of an hour with open questions such as: *Why is it important for the Dominican Republic to develop an educational program in Agroforestry? Who will be our target group?* What skills and abilities are needed in cocoa AF? as well as closed-ended questions in which respondents choose different topics to be covered in the Diploma and ways of learning were analyzed (Annex D). The topics were based on the International and local research done in the previous chapter. The interviews lasted an average of an hour with professors, technicians and leaders from companies. Students and farmers were given a quick survey to answer (20 min). There are 5 groups of stakeholders: Farmers (F), Technicians (T), Students (S), University professors Cacao Forest (U) representatives, and Organizations (Processors, Ministers, National Commission). Each stakeholder group was given a code according to the group that they belong to. Moreover, questions were tailor or simplified according to the group and according to a specific focus (Table 1).

Stakeholder	CODE	# of Participants	Method Used	Focus
Farmers	F	10	Survey	• Current Farmer situation (management practices) • Ways of Learning • Skills for agroforestry of cocoa • Topics that would like to learn
Technicians	T	7	Interview with semi-structure (close & open-end questions)	• Need of the program (WHY) • Ways of Learning • Topics that would like to learn • Willingness to take the course and limitations of the program • Strategies with farmers
Processors (CONACADO,FUBAROCA,COPROAGRO, smaller cooperative)	O	3	Interview with semi-structure (close & open-end questions)	• Need of the Program (WHY) • Skills for agroforestry of cocoa • Educational tools that have worked (current training workshops) • Policies that support agroforestry
Minister of Agriculture	O	1	Interview with semi-structure (close & open-end questions)	• Need of the Program • Skills for agroforestry of cocoa • Educational tools that have worked (current training workshops) • Policies that support agroforestry
National Commission of Cacao	O	1	Interview with semi-structure (close & open-end questions)	• Need of the Program • Skills for agroforestry of cocoa • What educational tools have worked (current training workshops) • Policies that support agroforestry

Cacao Forest (NGO)	NGO (U)	1	Interview with semi-structure (Close & Open-end questions) and meetings	• Training needs and stakeholders involvement • The need and Objective of the Program • Capacity of the Organization to facilitate the program • Educative method to use • Target audience • Skills for agroforestry of cocoa • Modules and topics
Local Universities professors (UNEV, ISA, UASD)	U	11	Interview with semi-Structure (Close & Open-end questions) and meetings	• Needs and objectives of the Program • Capacity of the University to teach the program • Current curriculum • Current educative method to use • Target audience • Skills for agroforestry of cocoa • Modules and topics
Graduated Students from Agroforestry program in UNEV	S	20	Survey	• Need of the program • Evaluation of Current Agroforestry Program (capacity of the university) • Willingness to take the course and limitations of a new program • Ways of learning

Table 1: *Classification of the stakeholders according to the research method use and focus*

Ethnographic style of interviewing was emphasized since the interviewer had limited knowledge. The aim was to identify the inside perspective or need of the stakeholders for an educational program in agroforestry of cocoa (Leech, 2002). Finally, inductive methods of analysis (thematic analysis coding) were used (Gery & Russell 2003) and quantitative data were analyzed in Excel.

Educational Committees meetings (Focus Group)

Three meetings were arranged with professors of the different universities and Cacao forest where objectives, topics, modules, pedagogical methodology were revised and discussed. The meetings were recorded with voice memos and then transcribed. They will be incorporated in each section accordingly.

4. Results and Analysis

4.1 Literature Review (RQ1)

4. 1.1 International Universities Literature Review

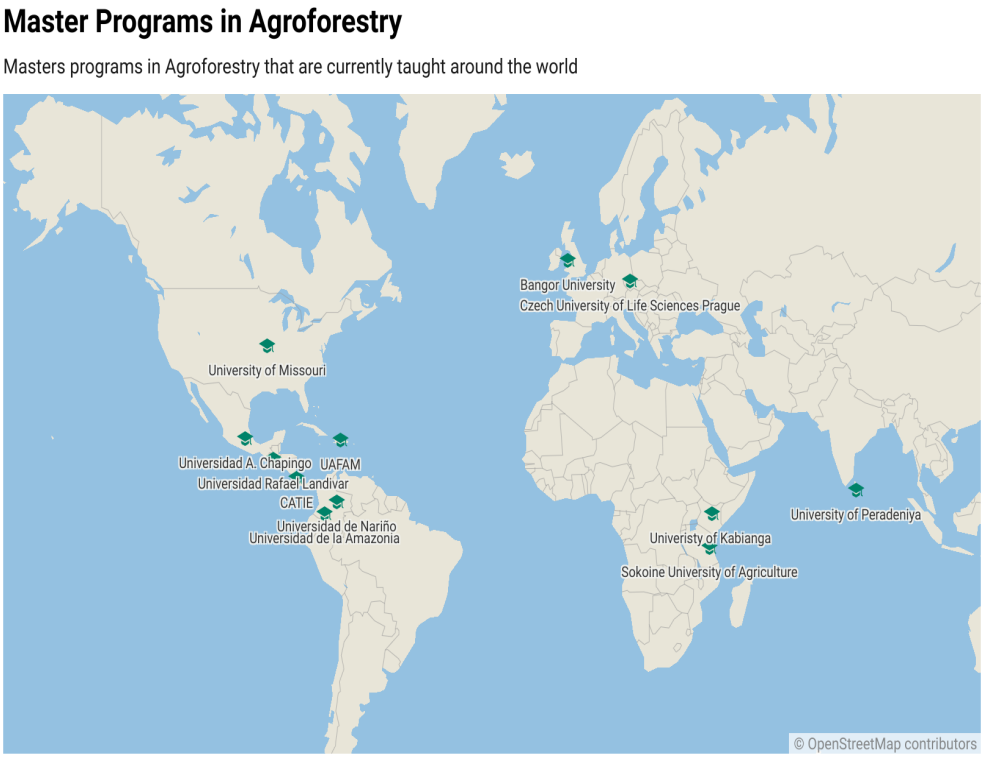


Figure 1. *Master Programs in Agroforestry around the world.*

A total of 13 master programs in Agroforestry were found and 9 certifications. Only 12 of the master programs and 9 certificates were used for this analysis since the other program did not have enough information. All this information was analyzed in Excel and cross checked with the paper: Directory of International Training and Educational "Opportunities in Agroforestry" (Miret & Bournes 1993) and from more up to date unpublished report written by Halpern 2020 "Best Practices for teaching in agroforestry".

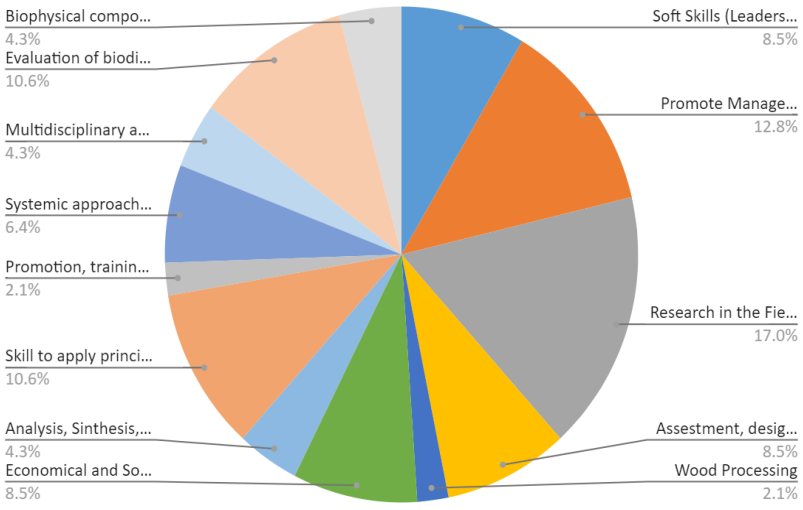


Figure 2. General Objectives for Master Programs in Agroforestry across the world

Master programs according to their objectives were very diverse but had "Developing skills for applied research in the Field" (17.02%) in common. This might imply that the program aims to develop researchers such as the case of Bangor University in the UK, CATIE in Costa Rica, Czech University of Life Sciences Prague in Csech Republic, and

others. This is not rare since agroforestry emerged as a science 40 years ago and bridging research and development has been the aim (Garrity et al 2006). Moreover, they also emphasized the topic of promoting management of agroforestry systems (12.8 %) which shows a high level of understanding of all the academic components and scientific objectives since master programs traditionally have this tendency (Temu 2010).However, the promotion of training, extension and consultancy in agroforestry is not taken into account by most of the programs which make us think about the connection to the farm. Often students are exposed to technical information and lack the practical training as well as the farmers traditional knowledge which is generally neglected in most curricula (Temu 2010). However, International Master programs bring interesting topics to the table such as “Food Security and Improvement of Quality of Life/poverty reduction” which was discussed with professors and it seems to be considered as a ‘first world subject’. If it will be taught it should be practical with classes to improve production or diversified farmer’s income which will lead to poverty reduction.

There are 9 certifications in the Americas that were taught by universities or their extension programs. There are 3 programs that specialize in training technicians which is a pre-university program. These programs last 24 months, while the other 6 programs are short courses with a duration of 84 hours to 3 months. There are 4 out of 9 certifications that are specialized in “Cocoa in Agroforestry systems '' in Ecuador, Peru, Nicaragua, and Honduras (See Annex Q for program details). Certificate programs take into account *Management of AFS* and

Figure 3. Certificate agroforestry programs in the Americas

Assessment, design,analysis, interpretation and application of the AFS but also have focused on developing specific applicable skills and practices of AFS such as *farm base line*, *production techniques in AFS*, *diversifying and maintaining production.* They also aim to update the learner with the *current situation of cocoa* and *in-depth knowledge* of everything related with *cocoa production, processing, and commercialization in agroforestry systems*. Two programs from Ecuador and Peru mentioned the ability to

analyze and make decisions about r*enovation and restoration*. One program in El Salvador promotes the use of participatory approach to identify problems and solutions in the farm with the farmer. This program also mentioned innovative educational tools such as webinars, field practices, case studies and the methodology of learning by doing (Annex E).

These *specialized certifications*: "Cocoa in Agroforestry systems" are more suitable for the current development of the educational program since it emphasizes practical and specific skills to develop. It is also necessary to develop in-depth knowledge of cocoa production based on the D.R.' s agroforestry systems and skills that will be mentioned in the interviews (the need).

Since one of the objectives from the "Cacao Forest Project" is to *renovate and restore* the current cocoa plantations in the D.R. A class in analysis and making decisions about this process should be included taking into account social, economic and environmental factors (Somarriba 2021) and the farmer as part of the AFS.

'Promoting the use of participatory approach to identify problems and solutions in the farm with the farmer' is an appealing option in this diplomado since in interviews technicians, and students mentioned the importance of being able to relate with the farmer. On one hand, farmers mentioned: *"Humble people are worth a lot"* referring to technicians that give advice in their farm which also reflects the sense that farmers feel that technicians show a sense of superiority. This was perceived in the interviews: " I tell him what he has to do and if he does not do it, sanctions are imposed". On the other hand, technicians also expressed their frustrations at not being able to convince farmers to make changes. Even Though most technicians interviewed have a university degree and some practice in the field. Therefore, a holistic way to interact with the farmers is key for the success of transferring information which is something relatively new to the D.R. Since their extension is based on "one solution fits all " with a single technology package, we know that farmers' needs vary (Anderson 2004).

Finally, we can concluded that both Master and Certificate programs aim to :

1) Promote management of agroforestry with a real emphasis on technical component excluding actors
2) Assess, design, analyze, interpret, and apply practices in agroforestry systems
3) Take into account Economical and social aspects in local Context
4) Evaluate biodiversity, natural resources and other ecosystem services (Carbon storage, pollination, potential use, among others)

It is interesting to see how Master programs (2 years) focus on diverse in-depth academic subjects, but not necessary in applied knowledge. Diplomados (84 hours to 3 months) focus on hands on and theory of the current available information but leaves behind some fundamentals for example soft skills which are assumed that it was developed before.

4.1.2 Summary of what and where the information from International programs can be used (References for each university Annex F)

Action	Results (Focus on)	Incorporated to ….	Conclusion (Included in the Curriculum)
Analysis of International Program: **"Master Programs"**	*Most used topics:* -Developing skills for research in the field - Holistic view and Evaluation of biodiversity, natural resources and other ecosystem services (Carbon storage, pollination, potential use, and others)	*The questionnaire topics to choose from:* - Developing skills for research - Holistic view of biodiversity, natural resources and ecosystem services	**Not Included** **Included**
	Less use topics that might be important to include : -Equity/ food security and improvement of the quality of life/poverty reduction - Soft Skills (Leadership, teamwork, attitudes and values) - Multidisciplinary approaches that promote the sustainable development of agricultural production systems	*The questionnaire topics to choose from:* - Food security and improvement of quality of life - Soft Skills The modules by adding economics of AFS, regulations, policies, certifications, industry and entrepreneurship	**Not Included** **Included** **Included**
Analysis of International Program: **"Diplomado in Agroforestry"**	*More specific skills:* -Farm base line - Promoting management in AF - Production techniques in agroforestry systems - Diversifying and sustain production	*The questionnaire topics to choose from:* - Farm baseline - Management in AFS - Diversifying and sustain production	**Included** **Included** **Included**

Analysis of International Program: **"Diplomado in agroforestry of cocoa"**	*More specific skills:* - Update the learner with the current situation of cocoa - In-depth knowledge of everything related with cocoa production, processing, and commercialization in agroforestry systems. -Ability to analyze and make decisions about renovation and restoration. - Promote the use of a participatory approach to identify problems and solutions on the farm with the farmer. - Innovative educational tools such as webinars, field practices, case studies and the methodology of learning by doing. *Less use topics that might be important to include :* - Apply basic knowledge in the propagation, establishment and agronomic management of fruit species	*The questionnaire for topics to pick from:* - Cocoa production, processing and commercialization in AFS - Renovation and restoration - Importance to relate with the farmer. - Propagation of fruit trees - Agronomic Management of other crops/trees Methodology of learning by doing was included in ways of learning of technicians, students, farmers	**Included** **Included** **Included** **Not included** **Not Included**

Table 2: *Incorporating International knowledge in the Diplomado*

4.1.3 Curriculum Analysis from University in the Dominican Republic (RQ1)

Generalities: There is a trend of decreased number of students for the career of Agroforestry engineering from 2008 to 20015 there were a total of 171 students (18.12% females, 81.8% males) enrolled in the agroforestry engineering program (UNEV & UAFAM) with 28 students that graduated (16.4%), and by 2016 there were only 146 students with only 16 students that graduated (6.3% females,93.7% males), (Mescyt 2005-2016).

a) Analysis of the overall possible classes within undergrad and grad programs in Agronomic, Forestry Engineering, Ecology & Environmental Management, Agroforestry Engineering, and Plant Protection: there are 9 Curriculums from 4 Universities (UNEV, ISA, UASD, and UAFAM) that were analyzed and classes were selected according to their direct relationship to agroforestry within the framework of agriculture, environmental management, social and economic issues (Rudebjer 2005).Moreover, according to *''Academic offer related to agroforestry in the Dominican Republic''* there are 63 clases which 26 classes are directly related with agroforestry and agroecology,17 with intermediate relationship and 19 with indirect relation to agroforestry or agroecology (Tiburcio, 2022). However,after analyzing the classes having in mind a broad spectrum of knowledge and skills from a range of classes that include agriculture, forestry, sociology,

economics, policy of curriculums in agroforestry (Rudebjer 2005), there are 42 clases that could be adjusted to teach in the *diplomado* depending on the tendency or overall objective (See Annex C)

b) There are only 5 programs with agriculture, agroforestry and forestry programs in the Dominican Republic:

Universities in the DR	**Program Name**	**Type of Program**
UNEV	Agroforestry Engineering	Undergraduate (4yr)
UAFAM	Agroforestry Engineering	Undergraduate (4yr)
ISA	Forestry Engineering	Undergraduate (4yr)
UASD	Sciences in Agriculture and Forestry Extension	Master Program (2 Year)
UAFAM	Agriculture and Sustainable Agroforestry	Specialization

Table 3: *Educational programs in agriculture, agroforestry and forestry in the DR.*

The programs have varied objectives (Annex G). But their main focus is on promoting, training, extension, technology transfer in Agroforestry, as well as scientific and technical/ methodological tools for agroforestry, within local economical and social context.

These programs have several classes in common such as Agricultural/Agroforestry Economics, Conservation of soil, Watershed planning and management, Forestry and Agroforestry Extension, Forest management ,Innovation & Applied Technologies to Agroforestry such as Photogrammetry and Geographic Information Systems which will facilitate choosing which university could teach those classes if they are incorporated into the Diplomado.

c) Moreover, each program has something unique that could be use:

University	**Different classes (Uniqueness)**	**Tendency**	**Incorporate to**

UAFAM	Agroforestry Management (Organic Farming)- General ecology- **Plant Propagation**-Agricultural genetics- Land Use planning- Organic agriculture- **IPM**-Administration of agroforestry companies-Agroforestry sociology-Cultivation and cropping	This program gives a sense of going from details about crops and how to protect them to how to manage an agroforestry company	The questioner by asking to choose the topics mentioned here as an option to cover within the diplomado: - Plant propagation,plant care - IPM
UNEV	Biological Pest control- **Design of agroforestry systems**- Ecology for agriculture- **Soil Ecology- Soil Microbiology-** Organic fertilization- **plant physiology**-Natural Crop protection- Fruticulture-Agriculture- Organic Horticultural products-Management of forest nurseries- agricultural and forestry zoning	This program has an organic and agroecological tendency. There are details about the functioning of agroecosystems, the soil as an important factor, pest control, and knowing how to manage first nurseries.	The questioner by asking to choose the topics mentioned here in bold as an option to cover within the diplomado
UASD	**Natural Resource Management** & Conservation- Design of agricultural experiments- Productivity,Improvement & sustainability in agroforestry systems-**Agricultural Business**	This program gives a sense of preparing students for research and conservation with some agronomic and business aspects.	Ask about including: Natural Resource as a base concept for the rest of the program Incorporate agricultural business aspects to the curriculum Ask about what theoretical knowledge should be included?
ISA	Associativity and productive groups (associations)- Forest harvesting and transport- Forest Protection- **Forest Policies and Legislation, Farm Diagnosis**.	Mainly focused on forestry but incorporates policies and legislation as well as Farm diagnosis that is not found in another program	Incorporates policies and legislation for agroforestry and Farm diagnosis to the curriculum

All of them	Economics - Conservation of soil- Watershed planning and management- Forestry and Agroforestry Extension- Forest management - Innovation & Applied Technologies to Agroforestry such as Photogrammetry and Geographic Information Systems	Different focus	*To questionnaires* to incorporate economics as a module. Ask about including topics: conservation of soil, watershed management and applied technologies to agroforestry. *Bring the discussion about*: Agroforestry Extension in one of the educational meetings (focus group) *Take into account:* -Included Economic and social aspects and context within the design of the structure of the Curriculum *Ask about*: how technicians and students relate to farmers and how efficient are they trainings (extension and technology transfer

Table 4*: Incorporating local knowledge in the Diplomado*

Local programs have in common promoting, training, extension, technology transfer in agroforestry/forestry, however; what is taught and efficiency of learning of the subject was not studied. The agriculture and forestry education system traditionally relies on a hierarchical model with its top-down approach and aims to create change at the lowest level- the receiver (Rudebjer 2005). Moreover, local educational programs are clearly divided into agriculture, agroforestry and forestry programs which means they are in different departments within the universities which might lack connections between programs, this leads to lack of integrated knowledge or understanding of other sectors (Temu 2010). This is the case of agronomic engineers in the D.R. where they lack knowledge in association of crops, trees and animals, or techniques to conserve soil and water in the system (interviews).

4.1.4 Gaps and Specialization of Cocoa

The curriculum was developed with the result from the interviews and meeting with the focus group. Changes were also made after the professors reviewed it in the meetings (Annex H).

In the current curriculum for the Diplomado; there are 4 modules with a total of 30 classes, of which 22 classes are not available in any of the current local programs analyzed since they are more specific to cocoa. Those classes are not taught in any of the local agroforestry/agriculture/forestry programs. Therefore, these classes could be filled with international professors or local speakers that have experience in the field of cocoa AFS (Annex I)

4.2 Stakeholder Analysis for the Educative Program

Stakeholder	**Stake in the Project or Interest**	**Impact of Change**
Farmers	Would receive advice from the technicians	High
Student & Technicians	Would take the course	Medium
Processors (CONACADO,FUBAROCA, COPROAGRO)	Would send technicians to take the course and could provide work for technicians/students	Medium
Smaller Cooperatives (Fermentation & Dry)	Would send technicians to take the course and provide work	Medium
Minister of Agriculture	Regulation in Agroforestry/could provide work	High
Minister of Education	Regulations in Education	Low
National Commission of Cacao	Could send people to the course	Medium
Researchers	Could facilitate the information for the course and would propose future research	Medium
Cacao Forest (NGO)	Project implementers	High
Local Universities (UNEV, ISA, UASD)	Administrators and Professors, provide future students and infrastructure	High
International University (ISARA)	Could bring students to the course from abroad	High

Table 5*.Stakeholder analysis for the program*

Knowing the role that each stakeholder plays within the curriculum development helps identify which questions should be asked to each stakeholder as well as identify where potential participants could be.

4.2.1 Importance and Influence for the Educational Program

	Low Influence	High Influence
High Importance	**A** Processors Farmers	**B** Cacao Forest Local Universities Researchers National Commission of Cacao International University (ISARA)
Low Importance	**C** Minister of Education	**D** Professionals/technicians Minister of Agriculture

Figure 4 : *Importance and influence of stakeholders for the program*

Including stakeholders in the curriculum development process can help identify competencies required by participants and suitable methods or tools to be used but it can also be overwhelming therefore, this is a simplified way to visualizing the perceived importance (indicates priority) and influence (the power) in the Education Program which in fact highlight the need to pay attention to the group that falls within the high importance but low influence such is the case of Processors and farmers (Rudebjer 2005; Rogers and Taylor 1998)

4.2.2 Participation Matrix within the Overall development of the Educational Program

Stage in the PCD cycle	**Type of participation**	**INFORM**	**CONSULT**	**PARTNERSHIP**	**CONTROL**
Training Needs assessment		Cacao Forest	Cacao Forest Local Universities ISARA	Cacao Forest Local Universities ISARA	Cacao Forest Local Universities ISARA
Aims		ISARA	Local Universities Cacao Forest ISARA	Local Universities	Cacao Forest
Planning		Cacao Forest ISARA	Cacao Forest ISARA Local Universities	Local Universities ISARA	Cacao Forest
Validation		ISARA Local Universities	Cacao Forest Local Universities ISARA Research Centers	Cacao Forest Local Universities ISARA	Cacao Forest ISARA

Implementation	Cacao Forest	Cacao Forest Local Universities ISARA	Local Universities IDIAF	Cacao Forest Local Universities ISARA
Evaluation	Terra ISARA Cacao Forest/COPIL	Local Universities Terra ISARA	Local Universities	Terra ISARA Cacao Forest

Table 6. *Participation Matrix for the program*

This table gives a broader idea of how to proceed with the involvement or participation of the main stakeholders within the different stages of development of the Program. This was used by the developer to analyze the appropriate participation (Rudebjer et al 2001). *For example,* the training needs assessment has to be informed to Cacao Forest, Consult, partnership and control with Cacao Forest, Local Universities and Isara. For the implementation, who is involved? It is controlled by Cacao Forest, local universities and ISARA.

4.3 Interviews and educational committee meetings (RQ1/RQ2)

General Information: A total of 54 people were interviewed (42 males, 13 females) reflecting the low number of women involved in agroforestry farming, education, cocoa technicians, organizational positions, and agroforestry graduate students.

After interviewing professors and people in other organizations (17 people), the target audience for this Diplomado are Graduate students were from careers such as agronomy, agroforestry, environmental science, and related careers. Moreover, it will also be for technicians that are already working in the field.

4.3.1 Target Audience

After interviewing professors and people in other organizations (17 people), the target audience for this Diplomado are Graduate students were from careers such as agronomy, agroforestry, environmental science, and related careers. Moreover, it will also be for technicians that are already working in the field.

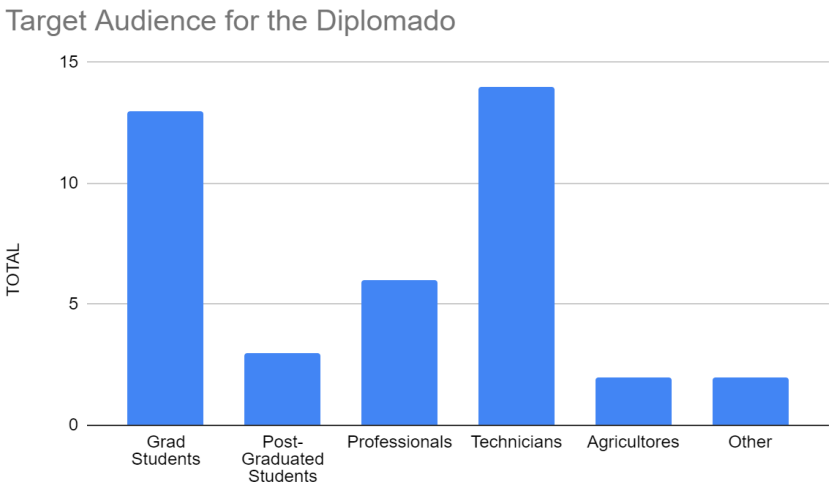
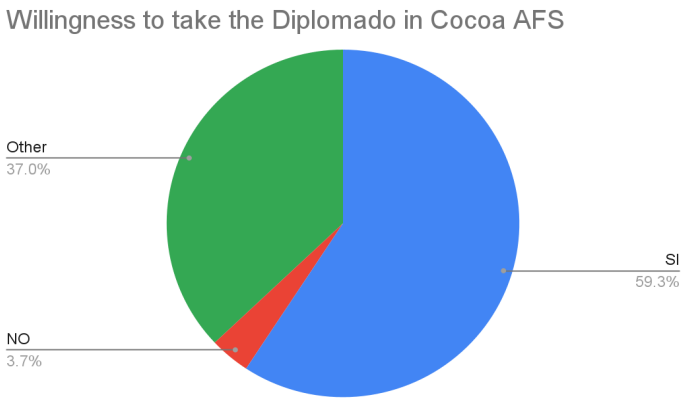


Figure 5 :*Target Audience for the Diplomado*

4.3.2 Willingness to take the Program

Moreover, the willingness to take the course was also measured by asking students and technicians (27 people)if they were interested in taking a program in agroforestry of cocoa



There is willingness to take the program: ”Cocoa in agroforestry systems”, another shown interest was for the courses in agroecology and more advanced courses such as Master programs in the same subjects. However, it was also mentioned that the programs need to be practical emphasizing hands on experience.

Figure 6: *Willingness to take the program “Cocoa in agroforestry system”*

4.3.3 Limitation to take the program

Knowing that availability of time is a limiting factor for students and technicians, the program will have to be designed in specific hours and days that accommodates the fact that technicians work a normal office schedule (8-5) from Monday to Friday. Moreover, location of the program will be also important to take into account since most of the field work, experimental farms, research centers, are located in San Francisco de Macoris, and students tend to be from agricultural rural areas. Cost should be taken into account as well as finding ways to be funded by other organizations.

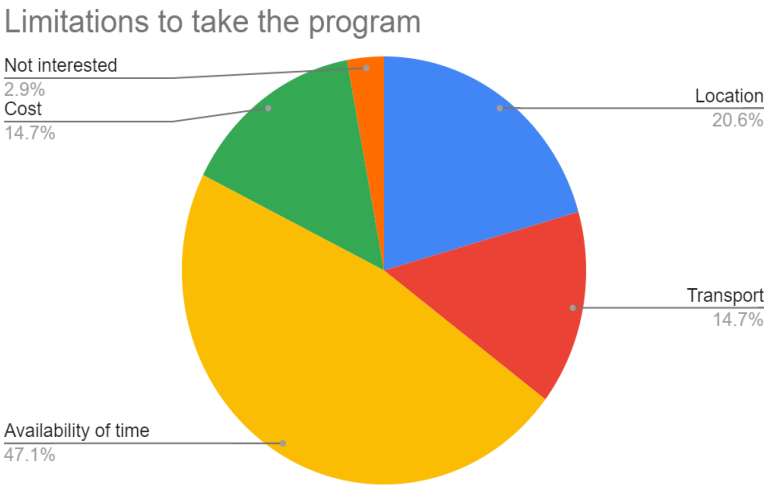


Figure 7: *Limitations perceive by students- technician to take this program*

4.4 Why do we need an educational program in agroforestry in the Dominican Republic?

Responders from different stakeholders groups (44 people) mentioned *the importance of the benefits that agroforestry* has as a system and in this case cocoa AFS; such as a way to mitigate climate change and enhance biodiversity, how association with other crops is beneficial and important (fruit, timber, animals) since they ensure other resources and it helps the economy of the farmer, agroforestry also helps with soil and water conservation, agroforestry is the balance between production and preservation, cocoa needs efficient forest environment and agroforestry provides it. Moreover, there is the *need for training technicians, and students* with technical skills so they can manage the systems and be able to avoid or prevent diseases/pests in plantations and be the ones who share the knowledge with others. There is also the *pressure of the world market demand of organic cacao* and high quality since Dominican Republic is already known as an organic producer and they want to be able to guarantee the future of organic cocoa and the delivery of a good product to the consumer.

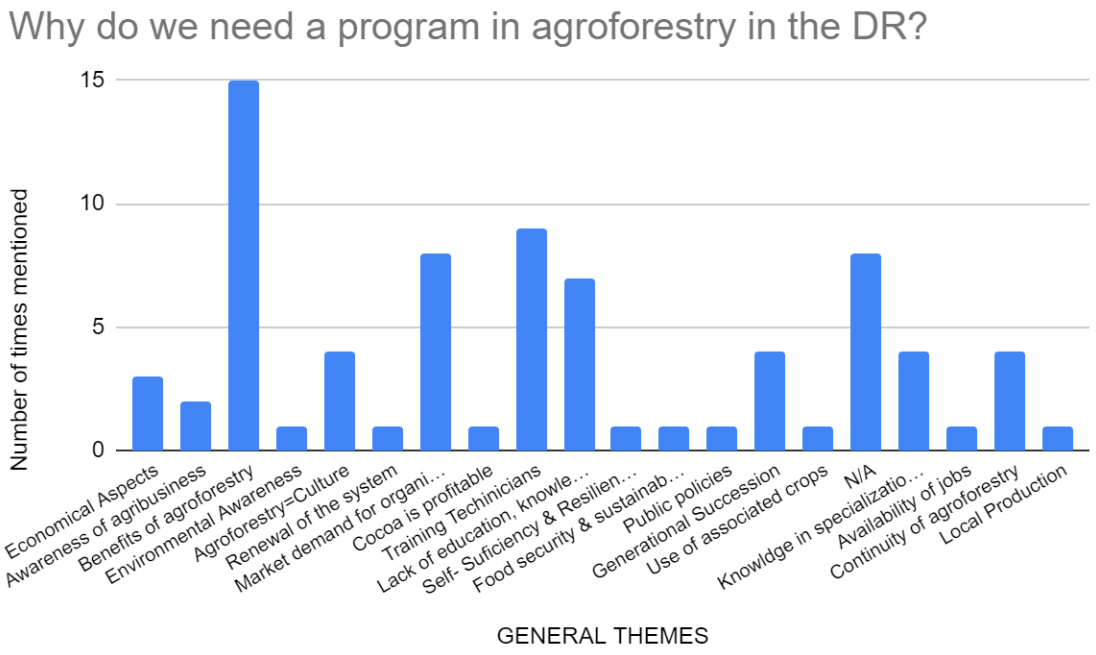


Figure 8: *Why do we need a program in agroforestry in the D.R.*

Several people mentioned that there is a constant high demand, good commercialization is already set up which generates income for people, and the market is relatively safe compared to other crops. It is also commonly mentioned that there is a *lack of trained technicians, people specialized in cocoa, lack of knowledge in general,* Also mentioned were other fact that we should have in mind: climate change, organic fertilization, lack of people interested in this type of system, and lack of professionals trained in cocoa cultivation with the local realities. There is a concern about the generation succession of the cocoa farmers; it is mentioned that knowledge in cocoa management will ensure that the practices are kept, that producer's children should be

incorporated into the training, that cocoa production needs to become more attractive for future generations, and that the next generations need to be encouraged and learn what it is to become agroforestry engineers.

Moreover, it is mentioned that *agroforestry is part of the DR's culture and that's really important for them* **"Marca Pais"**. A technician mentioned that " Agroforestry is a traditional way of cultivation and it has sustained families for years " (farmer), "Agroforestry has been part of Dominican's way of growing cocoa and coffee" (organization person). It is also mentioned that the traditional system can be improved to create more income (cacao forest operator). There is also the need for knowledge about taking care of crops, how to make the most of agroforestry systems, people in agronomy should learn about soil and water conservation as well as environmental, social and economic aspects of the agroforestry. There is also the need for students that specialize in specific subjects such as soil fertility, nutrition, phytoremediation, and entomology. Finally, it is mentioned that an educational program will encourage people to continue doing agroforestry, reinforce the knowledge to maintain the system, strengthen the development of agroecosystems and be able to identify people that want to specialize in cocoa production.

4.5 What do we need to teach/learn in this course?

4.5.1 *Skills to develop in the Diplomado*

All of the groups shared the following skills : *"Assistance and advice to farmers"*" they mentioned that the person needs to be able to relate with the farmer somehow and become a support person as well as working together with the farmer. This was emphasized also in focus meetings where the role of the extensionist has been forgotten in the current agroforestry programs. Another important skill was to have the knowledge in "*Management of Cacao in Agroforestry systems"*; to know about the shade that is needed for the cocoa plants, how to reduce the loss of cocoa in the field, how to manage workload in harvesting times, and know how to make compost and when to apply it. Moreover, 3 out of the 4 groups mentioned: there has to be a "*Reinforcement and expansion of knowledge about the AFS systems and practical skills"* that are used in the field. Another idea shared by some was to be able to "*Identify and understand complex agroforestry systems and agroecological practices as well as environmental and conservation practices".* Also*, soft skills* are emphasized with cooperative work, communication skills (be a good listener), leadership skills, developing their abilities in observation, being able to assimilate the information and trying to make connections. Finally, *skills to maintain a quality production*, be able to increase the production , close the production cycle, calculate/predict productivity and know when to renew the cocoa plants (Annex J)

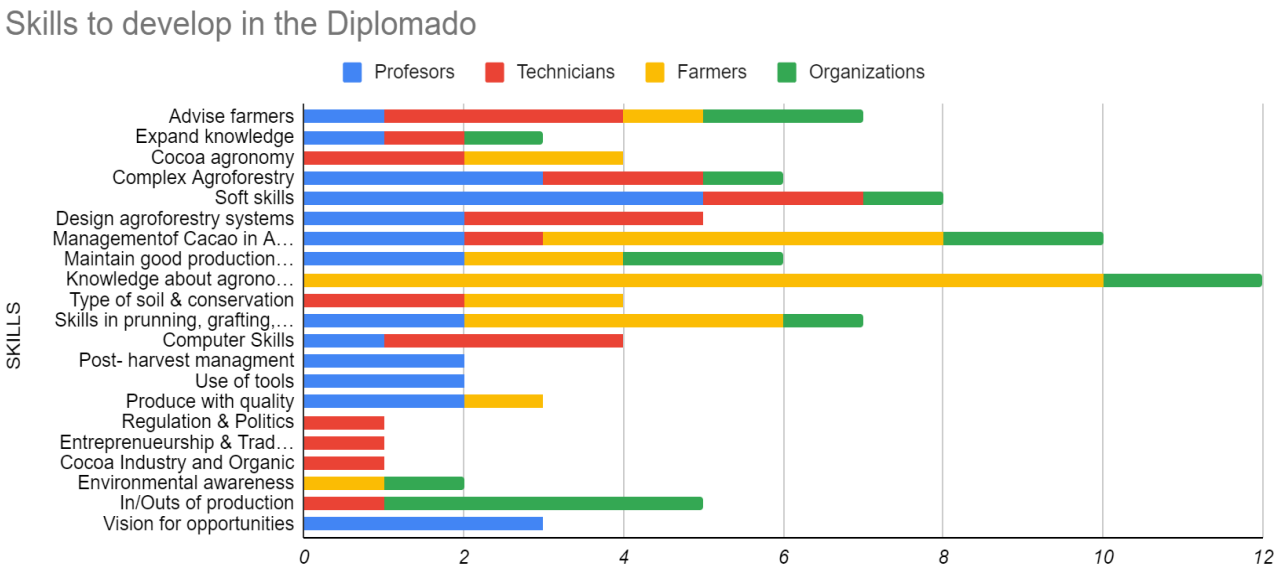


Figure 9: *Skills to develop in the Diplomado according to Interviews.*

It is interesting to see that most groups share the skill of *'Assistance/Advice to farmers'* (Relate with farmer support); however, professors slightly mentioned that while technicians thought it was very important to have that skill. Also, the different groups had different priorities and similarities about the skills that agroforestry should have; farmers and organizations mentioned that knowing about *cacao production* (how to plant, prepare soil, distances, care for trees, timeline, harvesting, processing) is really important while the rest of the groups did not think that. Technicians were the only ones mentioning wanting to know more about regulations and politics of cocoa, entrepreneurship and trademark registration, cocoa industry and organic cocoa in the D.R. This is a clear example of the gap between academia and practice that could be bridged by understanding and incorporating farmers' knowledge within the curricula, as well as having speakers from other stakeholder groups (Eksvärd 2004).

4.5.2 *The goal of the Diplomado (Profile of the Graduate)*

Professors (U),Cacao forest and Organizations (O) were asked about the goal of the Diplomado; the majority of people mentioned that the purpose or aim of the program should be to *share knowledge and train people in agroecological practices* and *agroforestry systems within the social and economic context of the country.* In addition, they mentioned the importance of *soft skills development* from the participants in order *to learn, assimilate, make connections,and achieve observational and communication skills.* Moreover, participants should have a clear idea about *the benefits of agroforestry*, *how to maintain good production* and *know how to measure quality of cocoa from the farm to the export*. Several mentioned to develop *scientific and technical knowledge*, *be able to lead and advise farmers in the production of cocoa*, learn and be able to manage agroforestry systems in a sustainable way, know about soil and water conservation techniques, *be able to create projects*, have *knowledge in post harvest handling* and *ways to promote the creation of byproducts of cocoa*, know how to *associate crops* for benefits to the farmer and the environment, know about policies that support agroforestry, and comprehend traceability of cocoa.

Goals of the Diplomado- Participants will:

- Develop scientific, theoretical and practical knowledge in the functioning,integrated management in AFS.
- Be able to plan,design and manage cocoa in AFS.
- Be able to analyze and make decisions in aspects of the farm through application of alternative methodologies (holistic and system thinking) and tools (fertility, erosion, canopy, farm diagnose and others).
- Be able to create social, environmental and economically viable projects in AFS
- Develop the skills to work in diverse teams, self awareness, critical thinking,and relate with farmer
- Applicability of methods for soil and water conservation within agroforestry systems.
- Expand, reinforce and share knowledge in AFS

4.5.3 *Modules Structure*

Previous work by Ernesto proposed a prototype of the structure of six modules for the diplomado. However, it was not revised by the professors therefore, an interview of interested groups was done with professors, Cacao Forest representatives, graduated students, organizations and technicians. Interviewees voted according to the importance and preference of including or not the module and suggestions were also added.Finally, a meeting with professors (focus group) helped revise the structure of the modules, and all their suggestions are stated.

Module 1: interviewees mentioned it could be helpful to include general plant physiology, and be able to understand & observe interactions between elements in nature as well to introduce current issues (environmental) that relate with problems in the DR. It should be practical and easy to understand through videos, activities,and field visits.

Module 2: respondents mentioned that perhaps yield calculation, shade/sun analysis, would be good to include as well as how to improve farmers income, and knowledge about renovation of the cocoa plantations by grafting.

Module 3: it is mentioned to focus on diversification of the cocoa AFS with crops that could bring revenue when cocoa is not available with other alternatives that have not been talked about like vegetable production in intensive cultivation. It is important to think of the farm as a system and not just as cocoa production.

Module 4: it is mentioned that processing and exporting of cocoa is important as well as fair price, and what it entails.

Module 5: Should focus on organic certifications and their restrictions.

Module 6: what are the requirements and protocols to create a company but in an applied case (practical)

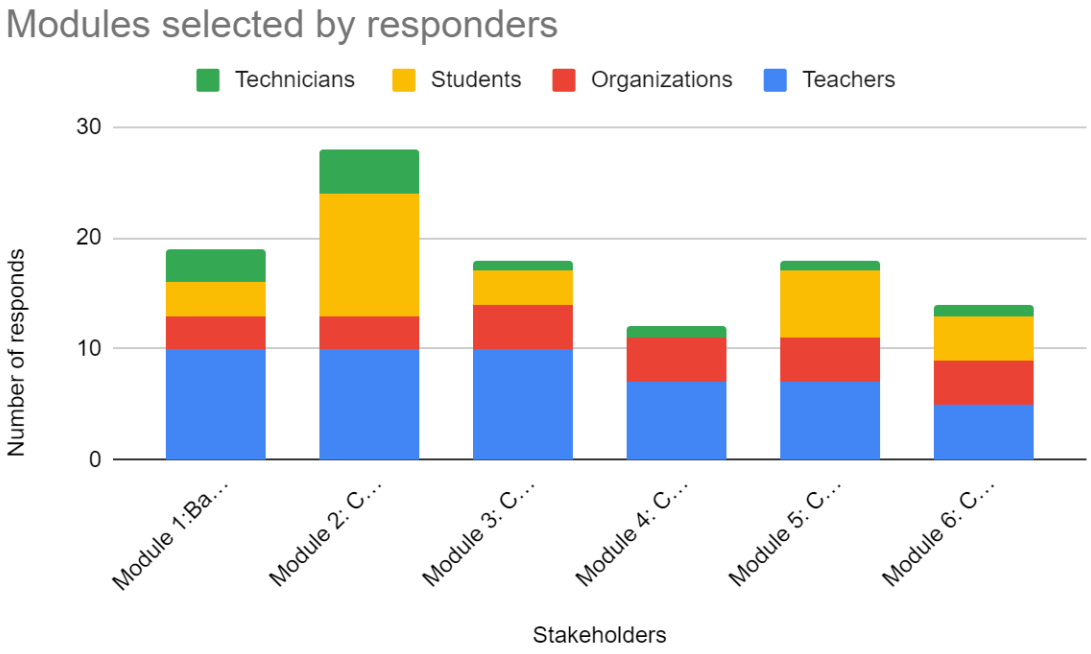


Figure 10. *Modules selected by the responders*

As it shows, *Module 2* is very important for the Diplomado which also tells us that people are interested in the know-how of agroforestry systems. *Modules* 2, 3, and 5 would give the basics for understanding and furthering the knowledge into action. However, changes have to be made to modules 4, 5 and 6 since there is not much support for teaching those as complete independent modules but they can be included as individual classes within an overall module with a different name. Moreover, it was mentioned that modules 5 and 6 could be a whole different Diplomado and since time is limited they could be individual classes within one module (Annex K).

4.5.4 Topics to include in the Diplomado

There were several topics to pick as important to teach and learn in the diplomado which was based on International topics used in other Diplomados or programs. In this case, only interviews to professors and organizations were taken into account.There were 19 topics to pick from and the most important topics that interviewers considered were:

The first most voted were:

- Management,Planning and Design of Agroforestry Systems
- Technologies and innovations (GIS, applications, sensors,etc)
- Agrobiodiversity
- Microbial and organic biofertilizers (Biological, compost, bokashi,others)

The second most voted topics were:

- Soft Skills (leadership, conflict management, communication, creative thinking, teamwork, and others)
- Carbon Footprint and Life Cycle Assessment (cocoa)
- Conservation and sustainability (water and soil)
- Pest and Disease Management in Agroforestry (IPM)
- Fruit Plantations and Fruit Growing
- Analysis, Evaluation and Implementation of Cocoa Farm Renovation and Rehabilitation (R&R)

Third most voted were:

- Watershed Management
- Farmer Knowledge (Local Information)

The rest of the topics such as; Food security and Improved quality of life were topics that could be taught very theoretically. Applied statistics and research methods were mentioned ,that are already found in the undergrad programs. Tropical dendrology, genetic resources and intellectual property, and landscaping were not part of the scope of the diplomado. Plant propagation (cuttings, plant care) was a specific topic that could be learned in the field. All of these topics received less than 10 points therefore they were eliminated in order to give more emphasis to the important topics. See proposed Curriculum in Annex L.

4.6 How should we teach this Diplomado? (RQ3)

4.6.1 Current pedagogic strategies used in Agroforestry in the DR

After interviewing professors from the 4 universities about the different techniques used at the university in Agroforestry , joining a group of students in field work and attending some classes,several conclusions were reached: currently, the teaching methodology in universities depends on the teacher, the teacher is provided with the curriculum that must be fulfilled within a general content and timeframe, and it is the teacher who develops the content and decides how to teach; it, generally this is lectures with powerpoint presentations. Some university departments track what they teach and how they teach it from time to time where students rank their teachers and their overview of the class. However, some universities lack surveys about their programs' content/aims/goals, efficiency of ways of teaching, updates of the subjects, and outcome of the programs.

In general, the classes are divided into theoretical classes (lectures), laboratory and field work in subjects that require field reinforcement such as tropical crops,organic fertilizers, and others. In addition, homework, presentations, practical work and exams are evaluated. The exams have the greatest weight (60-65%); the exams are a mixture of comprehension and memorization depending on the subject and the professor (Interviews).

In order to guarantee the success of the program some of the class formats should be kept such as lectures, field/practical work, and presentations.But some other techniques such as the use of case studies, group and individual work and projects, multiple experiences from abroad, use of update technologies such as shademode,and GIS for planning will be incorporated.

4.6.2 Proposed Methodology

An educational method to be used in the diplomado could be incorporating active teaching and learning. **Active learning** places the student at the center of the process and it's about their discovery of the knowledge rather than acting as a passive information receiver. Moreover, this technique improves understanding, retention of information and higher order cognitive skills (Konopka et al 2015). This methodology will help reinforce essential soft skills such as leadership, conflict management, communication, systems thinking, teamwork, and observation skills.

Professors mentioned that the students should be able to analyze and see what/how farmers are doing to increase production and be able to learn from the process. Therefore, we have discussed in meetings about the role of the extensionist and how important it is to have specific skills such as to be a good communicator, and to be able to relate and connect with farmers. They should also be able to listen, and to understand the farmer's situation and effectively introduce techniques by practicing in the field.

Moreover, active teaching/learning was talked about in the second meeting. As mentioned by the respondents, some of them had training in active teaching however, they haven't had the opportunity to apply it. Therefore, training will be recommended for the professors involved in the Diplomado to be on the same basis and idea (Vision Alignment).

Moreover, a **holistic approach** *(agroecology)* should be taken into consideration since agroforestry is a complex interaction between different parts and participants who should be able to see those parts but also perceive the whole system (Charles 2014).

4.6.3 Technicians current training and things to be improved

Technicians (7) were asked about the training that they received in cocoa AFS within the company that they work for. The most common training is pruning of cocoa, scientific data management,growing and monitoring the cocoa plant,and organic certifications;their formats have been field learning with class format and the use of practical tools (inclinometer). They were also asked: What would you like to learn that will help you become a better cocoa technician?. Most of them mentioned how to relate with the farmers, ways to persuade and efficient communication with the farmer, and being able to create a basic control system (data collection) to be managed by farmers.Moreover, they need to develop skill in computer programs such as Excel, georeferencing, processing data, and farm maps with GIS. Finally, they mentioned more technical knowledge in cocoa agronomy, soil management and advantages, development and benefits of trees and crops within the AFS, basic concepts of agroecology, agroforestry and environment. All industries have technicians in the field; there are an estimated 100- 200 farmers per technician. Technicians visit the farms 3 times a year and a record is kept for each farm, they also do follow ups, control and give advice to farmers in their production.

Fuparoca, RIZEK's NGO is the second biggest processor, and has efficient training programs for producers. They use Farm Field schools methodologies which include workshops, field days, farm demonstrations which have been successful according to the technicians because training is based on the experience and local knowledge of farmers and adds new concepts. This has facilitated the changes in the management of the farm

4.6.4 Educational tools that can be created to facilitate teaching of agroforestry with local information

In order to develop educational tools to facilitate teaching, we need to understand how our target group learns (Students & Technicians). Moreover, it is common knowledge that the adoption of new technologies (AFS) is affected by a number of factors like farmers' knowledge, skills, resources, and values as well as socio-economic and cultural background (Barman, 2013). Therefore,it is ideal to incorporate different ways of learning from: Technicians, and students who do not necessarily learn the same way due to the differences in acquired expertise and active use of expert knowledge (Kerka 2002). In fact, technicians who were interviewed had experience in the field of cocoa in AFS, while graduates have experiences from different sectors and different roles. Finally, it is important to incorporate farmers since they will be the end receptors of the information, and it calls for a non-directive learning approach to enable farmers to play vital roles in keeping cocoa AFS, technology development or knowledge and use (Barman, 2013)

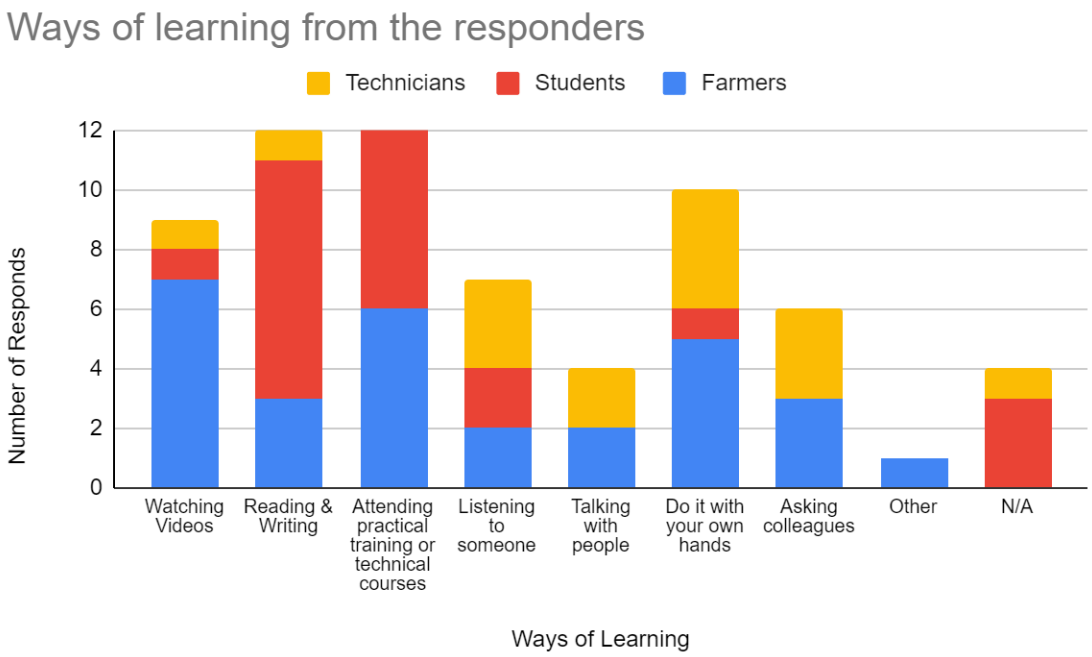


Figure 11. *Ways of learning from responders*

In all, 37 people were surveyed about their ways of learning new information (technicians, students and farmers)(Table 7).

Target Group	Ways of Learning	Possible Pedagogic Methods (Recommendations)
Technicians	Trying with their own hands	First let participant try themselves (ask questions about their current knowledge, knowledge by experience in the field, let them discover by themselves then elaborate and expand the content)
	Asking colleges about topics	Create teamwork activities or projects (Interactions between participants). Case Studies from the Cacao Forest initiatives could be the best tool to encourage group group and learning from techniques that have been used in the field.
	Listening to people about a topic	Lectures from professors,etc
Students	Read and write (Research)	Let students research specific topics that are interesting for them and it's related to the current module , then they could write about it and present.
	Attending practical trainings	Encourage participants to attend practical trainings (how is done) within the Diplomado
Farmers	Watch videos	Create or share videos that are easy to follow and understand but with enough information
	Attending practical trainings	Practical training should be interactive since farmers learn by doing it by themselves, promoting the interaction between participants of the workshop.

Table 7. *Ways of learning and recommendations for ways of teaching*

Since the target audience for the diplomado includes students and technicians (with experience) and their way of learning and needs differ, other ways of teaching should be incorporated such as letting students try first and then build on the subject (Technicians), research about a topic, then write and present (Students). Moreover, if we take into consideration international students that were not interviewed in this study other changes should be made according to their level of expertise, local language skills, and cultural understanding. The people in charge of implementation of the Diplomado should take into consideration the schedule of the Diplomado, time and length of the program even though there is a suggestion in this paper (10 Weeks with 120 hours), it should be re-evaluated once the content of the classes are decided.

Educational tools

From the ways of learning of the target audience it could be inferred that creating a Manual for Agroforestry with current cocoa AFS and experimental work done by Cacao Forest could be included as a guide for farmers, technicians, and students to maintain AFS. Not only for new farmers, and technicians to replicate these systems according to their regional agroecosystems but also to bridge the gap between academia and practice (Eksvärd 2004).However, an ethnographic study should be done about farmers' knowledge and what information could be transferable to the next generations, as well as their role within the cocoa AFS.

Resources and materials should be included; descriptive videos, lectures, workshops, and local case studies will help students understand and grasp complex ideas with local context (Annex M). A good example of an active lesson plan that incorporates the different ways of learning could be found in Annex N. Participants should also be exposed to a variety of instructors from professors, farmers, experienced field practitioners,and others.

As well as the development of soft skills through group projects, and individual reflections, the most important skill will be to assimilate the information and make connections in a practical way by being exposed to the situations in the field and in class.

Finally, there is also the need to train farmers. Farm field school will be appropriate for the current situation of cocoa production in the D.R. where these have only had limited use in the past.

5. Discussion

Education is at the heart of improving economic and eradicating poverty , as well as positive effects on productivity among farmers using modern technologies (Omoniyi 2013). Such is the case of cocoa AFS in the D.R. that is not necessarily a new technology but more research has been done in the last years therefore learning to apply them is still needed in the D.R.
This diplomado is really important for the D.R. not only because we are ensuring the next generation to have knowledge and practical tools in cocoa AFS but also because of the environmental, social and economic benefits of cocoa AFS of which professors and some stakeholders are well aware.Even though agroforestry has been practiced in the D.R. empirically and it is part of their identity, there is a lack of experts in the field of agroforestry and forestry since as it was mentioned the older generation has moved to high positions which could be inferred that there is lack of generation succession not only for farmers but also for people that study agroforestry.

In order to make cocoa production more appealing to younger generations, the Diplomado needs to take into account increasing profitability not only of cocoa but also from the whole AFS, incorporating the use of new applied technologies, practical training, and entrepreneurship.Including entrepreneurship will also encourage participants to create added value products from AFS within their communities which will create direct and independent income.

Those innovative ideas and by developing soft skills, design and planning of AFS, connecting and interacting between cocoa stakeholders, and incorporating innovative ways of teaching will attract the younger generations to the Diplomado.

Local programs have their uniqueness and forte however, only two universities (UNEV and UAFAM) are running the program in Agroforestry which makes us question the real demand for another program in agroforestry. If we compare it with other careers the demand is minimal however, there is a need for this Diplomado since it is more specific to the cocoa sector which will be the first one of its kind in the D.R. Moreover, the cocoa sector is in need of trained people with specific skills that will be able to transmit information and make an impact in how AFS are maintained.

The efficiency of the programs were not evaluated since universities don't have records about their program's performance, but it's clear that they have not reviewed or updated their programs. It is good to mention that

their way of teaching is traditional and relies on a hierarchical model with its top-down approach and aims to create change at the lowest level- the receiver (Rudebjer 2005). But the need to work with the farmer (lowest receiver) was evident throughout the interviews therefore we can say that; *Promoting, training, extension, technology transfer in agroforestry/forestry* is not working properly and this is key for ensuring the future of cocoa in AFS.

Moreover, there is the potential of 8 classes or more to be adjusted to the Diplomado, each university has specific classes and tendencies. The development of the content and ways of teaching of each professor should be aligned and agreed to the purpose of the Diplomado since the overall tendency will have agroecology as a backbone. I believe that the proposed methodology "active learning and teaching" is relatively new to the D.R. so there might be resistance to change however, incorporating several local teachers to different training, and relating with international professionals will ensure the success of the methodology.

Having in mind that there is a *decreased trend in students* that are taking agroforestry engineering programs and few are graduating from this field, there should be a revision and changes of the current curriculums in Agroforestry Engineering that are imparted at UNEV and UAFAM, this is supported by interviews done with graduated students from UNEV that mentioned that more practical tools should be included,as well as being able to develop their capabilities. Through the interviews, I was notified that the curriculum for UAFAM is being under revision and it will be updated to make it based on sustainability.

Moreover, the *number of female students involved in agroforestry* and the different stakeholder sectors (technicians, farmers, organizations, professors) are minimal and education will be a way to incorporate them into the cocoa sector.

As the meetings went on, the involvement of professors from different universities decreased and perhaps the Diplomado does not need all the universities to be part of it. I think that having two or three key universities will be enough since it is time consuming, and getting to feasible agreements is a challenge. Moreover, holding each university accountable to develop the specific class is also important but it will not occur by itself, it has to be initiated by Cacao Forest and ISARA. As mentioned before, training for professors involved in the Diplomado will be appropriate and need; a demonstrative workshop on *developing lesson plans* that includes active ways of teaching so professors can practice or learn other ways of teaching.

UNEV has not only the capacity to teach some of the classes and be the leader of this program but also provide more than 40 years of experience teaching agroforestry since it was one of the first universities in the D.R. teaching this subject. Moreover, they have a modern research center in Santo Domingo and a field campus with established agroforestry systems " Casta"in Villa altagracia. In my time at UNEV, I could perceive changes such as the Agroecology program was created and a Master program in agroecology is under development. These are both highly positive steps in the right direction. UNEV is looking to develop new programs but developing important skills and abilities in students. They have also graduated and supported Haitians education, and there is receptivity to make changes in their way of teaching.

The diplomado should have agroforestry systems, applied agroecological practices, natural resources conservation, environmental services and biophysical conditions as the base of the whole program because this will explain basic concepts for forward understanding and also people will become more aware of their environment.Some of those classes could be taught online and reinforced the knowledge in the field. The structure of the Diplomado could use the different methods (Annex O)

Moreover, the fact that I was facilitating the process and interviewing people, I became a key element for the development of the program. In order to implement the program, UNEV needs to take the lead and take the reins of the program. UNEV should take the initiative to create meetings to work collaboratively with the other universities (ISA or UASD) in the development of the classes, and create deadlines for it. Next steps can be found in the Annex P

Development of an educational program with participatory methods

It is crucial to analyze the willingness to take the course, target audience, the what, why, and how of an educational program before coming up with a curriculum since there should be a need for the program and it should be embedded in the social, economic, and environmental context of the country. The development of curriculums in the traditional way requires also an identification of the need and the groups that will take the course. In fact, in theory a general study is required in order to create a proposal; however, in reality this process is not done since it requires resources. This means that curriculum experts end up writing the proposal and professors, students, and other interested groups don't have a say. This curriculum aims to have perspectives and ideas from the different interest groups and incorporate them. Even though, this approach is not a total participatory approach per se, the process of creating the curriculum by interviewing people brought new ideas, created networking, questioning, created debates, gave the responder the opportunity to express their thoughts and feelings about different topics, gave a sense of importance and encouragement to underdogs groups that are generally neglected in a curriculum development

Interviews and meetings were an efficient method to acquire local information and understand the need of the program, what skills should be developed according to the actual situation, understand the actual situation and the aim of the program. The participatory approach was partially applied since meetings were mainly done with professors, and it would have been more beneficial if one representative from every group were able to attend the meeting, this could have better enriched the curriculum.

Interviews and meetings were time consuming but they emphasized the participation of stakeholders; however, that doesn't necessarily ensure the appropriation of the curriculum which will be a key factor for the development of the content of each class as well as the implementation of the Diplomado.

In general, the curriculum could be used for students and technicians in the D.R. but keeping in mind and accessing the level of the participants to make changes accordingly. Moreover, the curriculum should be revised and evaluated after the first group (Annex O).

6.Conclusion

Analyzing International programs has given basic ideas and understanding of the purpose of the programs, and from there on create an incentive to structure with classes that will ensure that the aim is accomplished. Analyzing local programs gives us an idea of what classes are available in the current programs that could be used for the Diplomado which also tell us if there are professors available to teach those subjects.However, this doesn't tell us about the quality of the education that is provided. Integrating a component of international and local knowledge was through adding topics or questions about specific subjects that should be included and establishing conversations (meetings).

Topics were selected according to importance,relevance and the need, trying to include the different opinions and suggestions from the stakeholders since they could vary a lot; finding the common themes and the differences was important.

The current way of teaching in Universities in the D.R. is traditional education therefore some skills have not necessary been developed such as soft skills, and there are weaknesses in local agroforestry programs such as Extensions which concise with the survey “Regional Assessment of Forest Education in Latin America and the Caribbean” done by the FAO in 2021. Moreover, there is a lack of incorporating other subjects such as entrepreneurship that are within other departments. Therefore, the curriculum for the Diplomado incorporates the current needs of the stakeholders and attempts to address the weaknesses of the current programs.

The implementation of the Diplomado will require the training of local professors,and speakers if the active learning/teaching methodology will be used, by incorporating international professors will also enrich the experience for the participants.

Moreover one of the educational tools that could be created is a guide of AFS with local experimental models, and farmers’ knowledge and livelihood. and case studies from Cacao Forest initiative. This will ensure a clear understanding about AFS in the D.R. as well as the continuity of the cocoa AFS. Moreover, there is a need for FFS where farmers could develop other skills, share experiences and needed practice to apply them.

This curriculum is flexible, multidisciplinary and aims to be inclusive with the participants by using different ways of learning (visuals,workshops, hands on, research, reflection, etc) ,applying active learning and teaching methodologies such as group projects, discussions, case study analysis, field visits,and others.

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Appendixes

Annex A: Process of developing the Curriculum in Agroforestry of Cocoa in the D.R.

Annex B: Overall classes taught in Local Programs

Classes that are taught in Programs of : Agronomic, Forestry Engineering, ecology & environmental management, Agroforestry Engineering, and plant protection that could be adjust for the Diplomado

Classes taught in the different programs	**ISA**	**UASD**	**UNEV**	**UAFAM**
Introduction to Forest Science	X			
Use and Conservation of soils	X	X	X	X
Agroecosystems	X			
Introduction to Agroforestry	X			X
Integrated Pest management	X		X	X
Commercial production of vegetables and protected agriculture	X			
Integrated management of crops	X			
Tropical crops	X			
Photometry and Photo Identification/GIS	X		X	
Agricultural and Forestry Economy	X	X	X	X
Agribusiness and Agricultural Economy	X	X		
Planning and Management of Forest Hydrology Watersheds	X		X	X
Forest Use and Transportation	X			
Politics and Legislation in Forestry	X			
Forest Management (+Lab)	X			
Farm Diagnosis	X			
Biological Control of Agricultural Production	X		X	
Integrated Tropical Pest Management	X			
Soil Fertility		X		
Agricultural Ecology		X	X	X
Soil Microbiology		X	X	
Natural Resource Management		X		
Fruit Growing	X	X	X	X
Design of agricultural experiments		X		
Rural Sociology (reality of rural DR)		X		X
Agricultural and forestry extension		X	X	X
Agricultural production and sustainability (IAG 8305)		X		
Introduction to Dominican Agriculture AGR-200			X	
General Plant Physiology			X	
Organic Fertilization			X	

Technology and Innovation applied to Agroforestry		X	X	X
Natural Crop Protection	X		X	
Management and administration of agroforestry companies			X	X
Marketing of Agricultural and Forestry Products			X	
Uso of forest products			X	
Forest management			X	X
Management of forest nurseries			X	
Agricultural Zoning			X	
Amendments and compost				X
Agriculture genetics				X
Land Use planning				X
Plant Propagation				X

Annex C: Classes taught in Forestry and Agroforestry Engineering Programs (Per University)

Classes	**UAFAM** (Undergrad Program: Agroforestry engineering)	**UNEV** (Undergrad Program: Agroforestry engineering)	**UASD** (Master Program: Agricultural and Forestry Extension Science)	**ISA** (Undergrad Program: Forestry engineer)
Natural Resource Management & Conservation			X	
Intro, Concepts, Agroforestry Systems	X			X
Agroforestry Management (Organic Farming)	X			
Agricultural/Agroforestry Economics	X	X	X	X
Photogrammetry and Geographic Information Systems		X		X
Soil Conservation	X	X	X	
Watershed planning & management (Forest Hydrology)	X	X		X
General Ecology	X			

Innovation & Technologies (Computer technology applied to Agroforestry)		X	X	
Design of agricultural experiments			X	
Productivity, Improvement & Sustainability in Agroforestry systems			X	
Plant Propagation	X			
Biological Pest Control		X		
Forestry and Agroforestry Extension and Dissemination	X	X	X	
Design of agroforestry systems		X		
Agricultural Genetics	X			
Land Use Planning	X			
Organic Agriculture	X			
Integrated Pest Management	X			
Forest management	X	X		X
Administration of agroforestry companies	X			
Rural Sociology (Rural reality DR)	X		X	
Agroforestry Sociology	X			
Cultivation/Cropping	X			
Agroforestry Enterprise Management	X	X		
Ecology for Agriculture		X		
Soil Ecology		X	X	
Soil Microbiology		X		
Organic Fertilization		X		
Plant physiology		X		
Natural Crop Protection		X		
Fruticulture		X		
Agriculture I		X		

Organic Horticultural Systems Design		X		
Marketing of agricultural and forestry products		X		
Utilization of forestry products		X		
Management of forest nurseries		X		
Agricultural and forestry zoning		X		
Agricultural Business			X	
Agricultural production and sustainability			X	
Associativity and Productive Groups				X
Forest Harvesting & transport				X
Forest Protection				X
Forest policies and legislation				X
Farm Diagnosis				X

Annex D: Questionnaire for University Professors

Why is it important for the Dominican Republic to develop an educational program in Agroforestry?

Who will be our target group?

What skills and abilities should an Agroforester have in the DR?

Mark with and X

Which basic concepts to Include in the Diplomado?

⬜Ecology

⬜ Agroecology

⬜Agroforestry

⬜Natural Resources

Which general topics should be included in the Diplomado of Agroforestry?

Module 1: Basic Concepts of Agroecology, Agroforestry and the Environment

Module 2: Cocoa Crop Management and Cocoa in Agroforestry Systems

Module 3: Cocoa Economics, Regulations and Policy

Module 4: Cocoa Industry and Organic Cocoa In Dominican Rep.

Module 5: Certification of Agricultural Products in Dominican Rep.

Module 6: Company Creation and Trademark Registration

Other specific topics that should be covered?

⬜Carbon Footprint and Life Cycle Assessment (cocoa)

⬜Management, Planning and Design of Agroforestry Systems

⬜Agrobiodiversity

⬜Food Security and Quality of Life Improvement

⬜Tropical Dendrology

⬜Technologies and Innovations (GIS, applications, sensors,etc)

⬜Conservation and Sustainability (water, soils)

⬜Applied Statistics and Research Methods

⬜Plant Propagation, Cuttings, Plant Care.

⬜Pest and Disease Management in Agroforestry (IPM)

⬜Genetic Resources and Intellectual Property

⬜Fruit Plantations and Fruit Growing

⬜Watershed Management

⬜Microbial and Organic Biofertilizers (Biol, compost, bokashi, etc.)

⬜Analysis, Evaluation and Implementation of Cocoa Farm Renovation and Rehabilitation (R&R), Quality and Production Chain

⬜Farmer Knowledge (local information)

⬜Soft Skills (leadership, conflict management, communication, creative thinking, teamwork, etc.)

⬜Landscaping

What kind of facilities does the university have to implement this program? (Ex: Labs,professors,etc)

Annex E: Objectives of International Master in Agroforestry programs

Universities	Soft Skills (Leadership, communication,multidisciplinary work team,actitutes/values)	Promote Management of Agroforestry	Research in the Field (Forestry & Rural Developement,etc)	Assessment, design , analysis, interpretation, and application	Wood Processing	Economics and Social Aspects/Context	Analysis, Sinthesis, Expand, Deepening of knowledge	Skill to apply principles and practices of agroforestry, scientific and technical tools	Promotion, training, extension and consultancy in AF	Systemic approach for the analysis and proposal of solutions to production and natural resource management problems	Holistic view and evaluation of biodiversity, natural resources and other ecosystem services (Carbon storage, pollination, potential use, etc)	Multidisciplinary approaches that promote the sustainable development of agricultural production systems	Biophysical components
Bangor University			X					X					
CATIE	X	X	X	X									
Czech University of Life Sciences Prague	X		X	X	X								
University of MISSOURI		X				X							X
University of PERADENIYA		X					X						
Sokoine University		X	X						X				

of Agriculture													
Universidad Rafael Landivar							X	X		X			
Universidad de Ciencias aplicadas y Ambientales (UDCA)			X							X			
Universidad de la Amazonia	X		X								X		
Universidad Autónoma Chapingo			X	X		X					X	X	
Universidad de Narino		X		X				X		X	X		X
UAFAM (Fernando Arturo de Meriño Agroforestry University)	X	X				X					X	X	

Annex F: Objectives of the International Agroforestry Certificate Programs

Themes (objectives) /Certificate Programs	*Programa del Diplomado en Agroforesterí a: Integrado en Bachillerato General (El Salvador*	*Curso Corto en Línea: Agroecología y Sistemas Agroforestales (USA)*	*Curso Diplomado de Titulacion, Sistemas Agroforesta les, Innovación y transferenc ia de tecnologías (Mexico)*	*Diplomado Internaciona l en Cacao (Ecuador)*	*Diplomado virtual práctico: "Agronomía, Agroforestería, Renovación y Rehabilitación, y Calidad para la producción sostenible del cacao" (Perú)*	*“Diplomado sobre producción de cacao bajo sistemas agroforestales” (Nicaragua)*	*"Diplomado de Producción en Cacao en Sistemas Agroforestale s" (Honduras)*	*Técnico Universitario En Agroforesterí a (ALTIPLANO-Guatemala)*	*Técnico en Agroforeste ría (Panamá)*
Promote Management of Agroforestry	X	X		X	X	X	X	X	X
Applied research in the Field					X				
Assessment, design , analysis, interpretation, and application		X		X	X	X			X
Economical and Social Aspects/Context		X						X	X
Skill to apply principles and practices of agroforestry, scientific and technical tools	X	X		X		X	X		
Promotion, training, extension and consultancy in Agroforestry	X						X		

Holistic view and evaluation of biodiversity, natural resources and other ecosystem services (Carbon storage, pollination, potential use, etc)			X	X	X	X		X	
Applied knowledge in the propagation, establishment and agronomic management of fruit species (traditional crops/export)	X							X	
Integrated Mng of hydrographic basins	X								
Participatory approach to identify problems and solutions	X								
Legislation and regulation in the use and management of natural resources	X								
Farm Base line & Management	X			X		X			
Methods to: strengthen the resilience of LA agricultural landscapes and their capacity to offer healthy food and ecosystem services		X							

Life cycle and the annual cycle of agroecological management of the cacao plantation				X		X			
Renovation and Restoration				X	X				
Current situation of cocoa as a crop				X		X	X		
Diversified and sustain production				X	X				X
Technical/marketing and commercial skills (cocoa/other)					X	X		X	
Interpretation of soil analysis, and calculation of fertilizer doses, identification of nutritional deficiencies, diagnosis of canopies					X				
Integrated crop Management (IPM)					X			X	
Post harvest management of cocoa and certifications						X			
Promote Generation Renewal						X			
Application of good agricultural practices						X	X		
Production techniques in agroforestry systems							X	X	X
Agribusiness administration/commercialization								X	

Entrepreneurship								X	
Benefits and Artisan processing of Cocoa						X	X		

Annex G: Objectives of the Local Programs (Forestry and Agroforestry Engineering Programs) per University

Objectives by themes	**UAFAM** (Undergrad Program: Agroforestry engineering)	**UNEV** (Undergrad Program: Agroforestry engineering)	**UASD** (Master Program: Agricultural and Forestry Extension Science)	**ISA** (Undergrad Program: Forestry engineer)
Promote Management of Agroforestry	X			
Research in the Field/ Use of Research	X		X	
Assessment, design , analysis, interpretation, and application	X		X	
Local Economical and Social Aspects/Context		X	X	X
Analysis, Sinthesis, Expand, Deepening of knowledge	X		X	
Skill to apply principles,processes and practices of agroforestry	X			
Promotion, training, extension,technology transfer in Agroforestry	X		X	X
Scientific and technical/methodological tools	X		X	X
Natural resources and their potential use in sustainable way		X		X
Evaluate, Predict, avoid environmental impact	X		X	
Manage agroforestry companies	X			
Integrated agriculture, forestry, livestock components in production systems		X		
Agroecological Approach		X		
Greater Profitability & Competitiveness		X		
Promoting partnership in productive communities.			X	
Support the implementation of programmes for rural development.			X	X
Solid ethical formation and a high social and environmental commitment				X
To make appropriate decisions in the establishment, production and sustainable management of natural				X

resources and forests				

Annex H: Revised Curriculum and classes in second Focus Meeting

Module 1: Basic Concepts of Agroecosystems, Agroforestry and Environment Reviewed					Reviewed by: Cesar Lopez (UNEV) Ma.Fernanda (ISARA), Gilberto Gomez (ISA)	
OBJECTIVE OF THE MODULE :						
1) Create environmental awareness, human-nature relationship and develop critical/holistic thinking	2) Acquire conceptual bases that will allow you to clearly understand the following sections of the course		3) Develop knowledge about ecosystems and their functioning		4) Skills: To develop observation and research skills, teamwork, compare-contrast.	
GENERAL TOPIC	**Subtopic**	**Approved (YES/NO)**	**Comments**	**Recommendations**	**Requires Field work?**	**YES-Where?**
Ecosystems	Natural Ecosystem and Agroecosystems (Transformacion, similarities and differences)	YES		Include Diagram that Alteiri uses in his presentation : "Agroecology Basis Master Class" by Marc Mcleab-Relationship between human intervention and biodiversity loss	YES	On the way to somewhere (Observation of the area)

	Conventional Production and Environmental Degradation	YES	Talk about 4-5 crops we depend on in the world (wheat, corn, rice, etc.)	Environmental problems and environmental degradation in the Dominican Republic	YES	Observe in the field the contrast between conventional agriculture and agroforestry (Near La Vega).
Agroforestry	Agroforestry Systems (General)	YES		Agroforestry Systems (Humid-Subhumid Tropics)	YES	Visitar una parcela de Cacao Forest
	Future and perspectives of Agroforestry at global and local level.	YES		Agroforestry Systems Worldwide (Arid & Semi Arid/Temperate)	YES	Visiting a Cacao Forest farm
Managment and Conservation of Natural Resources	Biodiversity (Agro-diversity)	YES		Seed diversity, Agro-diversity in the Dominican Republic according to life zones (rainfall distribution, climate, altitude, etc) Ex: Mango in Bani and its varieties	NO	
	Biogeochemical cycles (Carbon, Nitrogen, Phosphorus)	YES	Use easy-to-understand		NO	

			educational videos			

Module 2:MANAGEMENT, PLANNING AND AGROFORESTRY DESIGN OF COCOA PLANTATIONS				Reviewed by: Cesar Lopez (UNEV) Ma.Fernanda (ISARA), Gilberto Gomez (ISA)		
OBJECTIVE OF THE MODULE						
1) Basic knowledge of the cocoa plant, varieties and their requirements *(Should be revised)*	2) Has the knowledge and skills for land, watershed use and conservation.	3) Develop capacities to plan, design, establish, manage and monitor cocoa agroforestry systems appropriate to the geographical, social, etc. environment.			4) Integrated Farm Analysis and Identification of Farmer Needs and Problems	
GENERAL TOPIC	**Subtopic**	**Approved (YES/NO)**	**Comments**	**Recommendations**	**Requires Field work?**	**YES-Where?**
Cocoa Agronomy and Cocoa Varieties	Plant physiology, soil, water, nutrient requirements, etc.	NO	It could be a basic background on the cocoa plant and its varieties.	Students could do research on clones - This will add in the future Master	NO	
	Cocoa varieties (clones, benefits, requirements, etc.)	NO			NO	
Soil Use and Conservation	Soil factors and types of agricultural soils (Physical factors and conductivity)	YES			NO	
	Soil Microbiology (Basic)	YES	Simple and with videos	¨ Soil Tropic Network¨	YES	To be determined

	Soil erosion (Process and control)	YES		Soil preservation activities: live bunds, contour lines, diversion ditches. Accumulation of organic matter	YES	To be determined
	Water Conservation Structures (permanent and temporary)	NO	It is not necessary or can be included in the soil section.		YES	To be determined
Integrated Crop Management	Integrated crop Management (interactions)	YES			YES	To be determined
Pest control methods	Integrated Pest Management (Preventive Actions, Cultural Control, Direct Control)	YES	Exchange subtopic by topic		YES	To be determined
Design and Management of Agroforestry Systems	Natural succession of species. Crop association/rotation. Planting density and shade	YES	Add Crop Association	Short century crop rotation. Visual with photos. Shade can use applied technologies	YES	To be determined
	Planning, design and monitoring of agroforestry systems with various factors, purposes and benefits in mind (using ICT).	YES		Take into account the market demand as well. Make it practical and allow students to create something.	YES	To be determined
	Implementation of Agroforestry Systems	YES		Practical work for students	YES	To be determined

	(Incorporating ICT)					
	Monitoring and Evaluation of AFS (ICT) + Cacao Forest Designs and Experience	YES		Show how Cacao Forest does its monitoring and evaluation of the systems.	YES	Cacao Forest Experimental Farms
	Agro-silvopastoral systems in cocoa?	YES		Incorporation of small animals (chickens, pigs, sheep, goats, etc).	YES	To be determined
Farm Diagnosis	General Farm Analysis (Baseline) and identify/understand the Farmer's needs and problems (Holistic Approach).	YES		Baseline is very necessary. Take into account people's barriers to change. Show visual results for understanding	YES	To be determined
	Cocoa fertilization and post-harvest (Microbial and organic bio fertilizers/Biol/Compost/etc)	Perhaps separate them	Microbial biofertilizers, etc. - Post Harvest: Fermentation (Domination of Origin, etc.)	Take into account the post-harvest requirements: No more than 24 hours can pass from harvest to delivery, the care that must be taken when opening the cocoa pod (Machete vs. manual), chop the cocoa husk into small pieces so it decomposes faster,	YES	To be determine

				the bucket must be clean.		
	Analysis, Evaluation and Implementation of Cocoa Farm Renovation and Rehabilitation (R&R)/Canopy Diagnosis	YES			YES	To be determined

Module 3:Cocoa Economics, Regulations and Certifications				Reviewed by: Janina Segura (IDIAF), Sebastian Cardenas (Cacao Forest),Windston Marte (UASD), Jorge Calderon (Cacao Forest)		
OBJECTIVE OF THE MODULE						
1) Economic valuation of cocoa under associated systems		2) Cost of production, cocoa flow at national and international level, possible products of cocoa agroforestry.		3) Use and knowledge of applied technology in agroforestry, organic certification requirements, etc.		4) Be able to identify possible Agroforestry products and feasibility
GENERAL TOPIC	**Subtopic**	**Approved (YES/NO)**	**Comments**	**Recommendations**	**Requires Field work?**	**YES-Where?**
Cocoa Associated Crops: Tropical Crops and Fruit Trees	Fruit Plantations and Fruit Growing	NO	Review: Belongs to another section!	Put it into the 1.2	YES	
	Commercial vegetable production and protected agriculture	YES	Review: Belongs to another section!	Compare Production Plot and Model Plot	YES	Agroecological Farm

Agricultural Economics, Forestry in cocoa	Cost of production and profit, local and international cocoa trade flow (Case: Cacao Forest)	YES	2 Subtopics: Methodological theory of cost, cases cocoa forest		NO	
Use of agro-forestry products	Marketing of Agricultural and Agroforestry Products (Cocoa agroforestry production by-products)	YES	Cocoa forestry cases - Include market trends - International Commitments	Innovation in production/processing - Innovation of associated products - Added value	YES	
Information Technology applied to Agroforestry o Innovation and transfer of agricultural and forestry technology	GreenSeeker (Crop Sensor/health)-ArcGIS-tetracam multispectral camera-other	YES	Updated used technologies		YES	
Organic cocoa certification in Dominican Rep.	Requirements, Advantages, Disadvantages, and Processes	YES		Guest Expert Talk	NO	

Module 4:Cocoa Industry, and Entrepreneurship				Reviewed by: Janina Segura (IDIAF), Sebastian Cardenas (Cacao Forest),Windston Marte (UASD), Jorge Calderon (Cacao Forest)		
OBJECTIVE OF THE MODULE						
1) Ability to analyze/identify cocoa quality in the farm and in the industry, traceability, losses, possible contamination	2) Knowledge about the cocoa transformation process, the industries in the DR, the potential of cocoa not only as a raw material but also as a final product and derivatives.		Developed capacities to establish productive enterprises (personal, family and community) in the production, transformation and commercialization).		4) Leadership skills, and entrepreneurship.	
GENERAL TOPIC	**Subtopic**	**Approved**	**Comments**	**Recommendations**	**Requires**	**YES-Where?**

		(YES/NO)			Field work?	
Cocoa production chain	Important aspects of flavor, purity and physical characteristics of cocoa (Quality Control)	YES	1.1 Description of the cocoa chain 1.2 Cocoa post-harvest management and handling 1.3 Cocoa attributes (Fine and Aroma Dominican-Define and connect with positioning)	Expert Lecture	YES	CONACADO-COPROAGRO-RIZEK
Processing	Market requirements: Tasting and flavor profile, cocoa bean grading (Rizek or Fubaroca).	YES	Sensory analysis	Expert Lecture	YES	RIZEK
	Cocoa processing/ Denomination of Origin/Traceability and Possible contamination	YES	It should go in differentiation and certifications	Field visit plus theory	YES	
Agroforestry Entrepreneurship	Qualities of an entrepreneur (teamwork, emotional intelligence, leadership, etc).	YES		Expert Activity	NO	
	Planning, design of entrepreneurship project (Practical Exercise)	YES	Process Records - Business Management - Market Intelligence - Review Depth of Exercise (Time) (Link or start in Economics module - Establish all theoretical)	Link to agribusiness	NO	

	Classes Available in the Local Curriculums
	Classes not available

Annex I: Gaps-Classes that are not taught in the local programs analyzed

Module 1:

- Conventional Production and Environmental Degradation
- Future and perspectives of Agroforestry at global and local level.
- Biodiversity (Agro-diversity)
- Biogeochemical Cycles (Carbon, Nitrogen, Phosphorus) and Biophysical Conditions that influences AFS

Module 2:

Cocoa agronomy and varieties

- Plant physiology, different clones (soil, water and nutrient requirements)
- Integrated Pest Management (Preventive Actions, Cultural Control, Direct Control).
- Natural succession of species. Crop association/rotation. Planting density and shade
- Planning, design and monitoring of Agroforestry systems thinking about various factors, purposes and benefits (Using new technology: Gis,etc).
- Implementation of Agroforestry Systems (Incorporating ICT)
- Monitoring and Evaluation of FFS (ICT) + Cacao Forest designs and experience
- Agro-silvopastoral Systems in Cocoa

Farm Diagnosis

- General Farm Analysis (Baseline)
- Identify/understand Farmer's needs and problems (Holistic Approach)
- Cocoa Fertilization and Post-Harvest (Microbial and Organic Bio Fertilizers/Biol/Compost/etc.)
- Analysis, Evaluation and Implementation of Cocoa Farm Renovation and Rehabilitation (R&R)/Cocoa Canopy Diagnosis

Module 3:

- Cost of production and benefits, local and international cocoa trade flow
- Organic cocoa certification in Dominican Rep

Module 4:

Cocoa production chain

- Important aspects of flavor, purity and physical characteristics of cocoa (Quality Control)
- Processing Market Requirements: Tasting and Flavor Profile, Cocoa Bean Grading (Rizek or Fubaroca)
- Cocoa Processing/ Denomination of Origin/Traceability

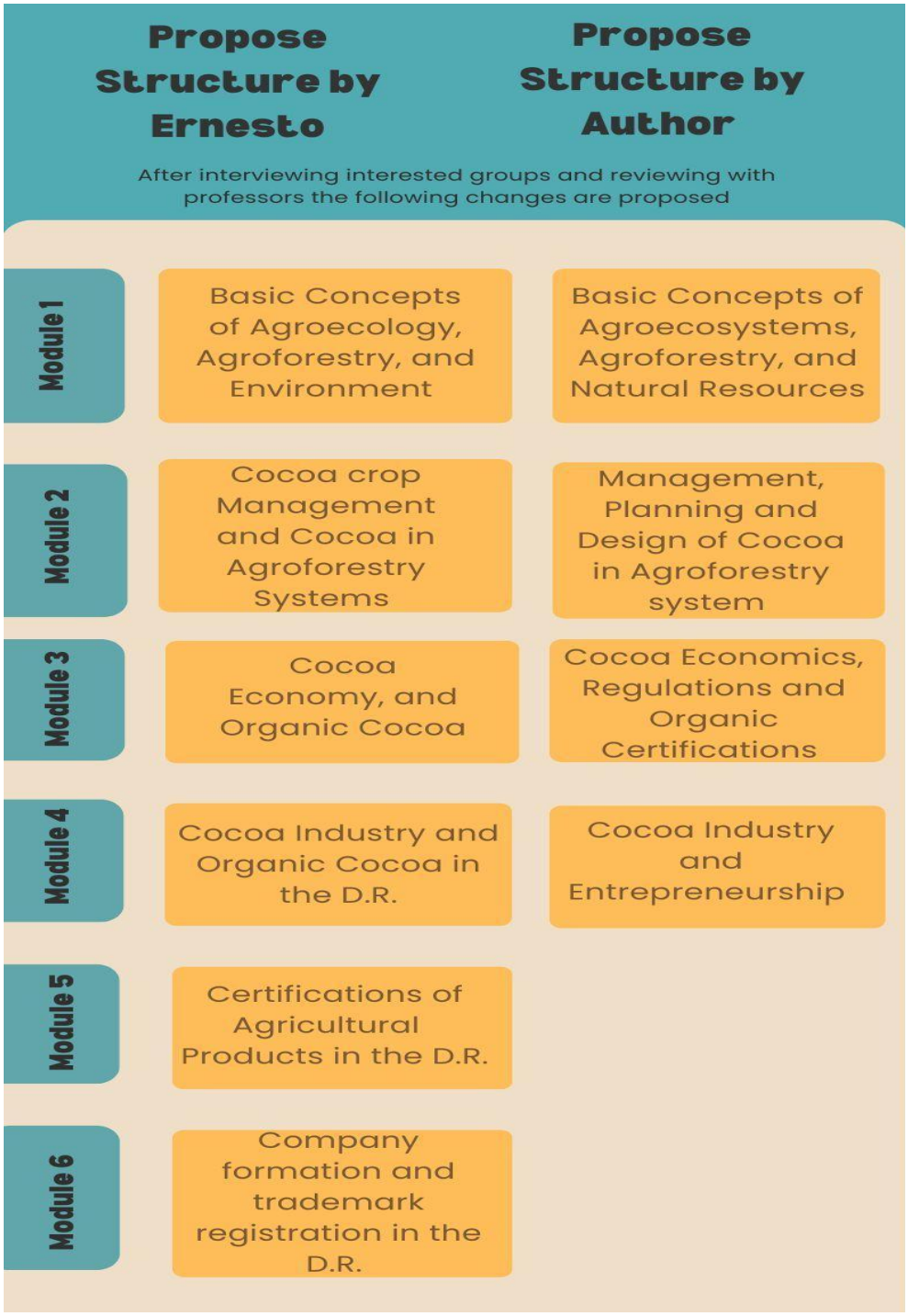
- Qualities of an entrepreneur (teamwork, emotional intelligence, leadership, etc).
- Planning, design of entrepreneurship project (Practical Exercise)

Annex J: Skill to develop in the Diplomado according to the stakeholder groups

Skills	Professors	Technicians	Farmers	Organizations	TOTAL
Assistance/Advice to farmers (Relate with farmer, support)	X	X	X	X	9
Reinforced/expand knowledge and practical skills	X	X		X	4
Cocoa agronomy (disease, clones variety,etc)		X	X		4
Identify and understand complex Agroforestry, agroecological practices , environment and conservation	X	X		X	6
Soft skills (work cooperatively, communication, good listener/understand, leadership skills, observation, work cooperatively, assimilate information and make connections)	X	X		X	8
Ability to design agroforestry systems (distances, purpose, benefits)	X	X			5
Management Of Cacao in Agroforestry systems (shade, reduce waste,workload,fertilization(compost)	X	X	X	X	10
Maintain good production/quality/increase production and be able to close the production cycle	X		X	X	6
Knowledge about cacao production (how to plant it, prepare soil, distances, care of it, timeline, harvesting, processing it)			X	X	12
Know the type of soil and soil conservation techniques and advantages (moisture, salinity, etc)		X	X		4
Skills in pruning, grafting, prograpation	X		X	X	7
Skill in computer Programs (Excel, georeferenciacion, processing data, farm map with GIS, drones,sensors,)	X	X			4
Post- harvest management (new products with added value)	X				2
Know how to use tools (knives, chainsaw, shovel, rake)	X				2

Produce with quality, able to calculate productivity and future renew of the trees	X		X		3
Regulation and Politics of Cocoa		X			1
Entrepreneurship & Trademark registration		X			1
Cocoa Industry and Organic Cocoa in DR		X			1
Create Environmental awareness (balance of production and conservation/impacts of monoculture/resources available)			X	X	2
In/Outs of production, funding (economy), commercialization (credit available for farmers, who they can sell the cocoa, etc)		X		X	5
Have a vision for opportunities and visualized how the system can be improve to produce more	X				3

Annex K: Proposed changes after interviews and focus group meetings



Annex L: Final proposed educative curriculum

"Cocoa in Agroforestry System"

MODULE 1

Cocoa in Agroforestry Systems	**Duration:** 2 Weeks	**Professor in Charge of the Module:**					
Basic concepts of Ecosystems, Agroforestry and Natural Resources	**Face-Face Class**	**Virtual Class**	**Tutorial**	**Field Visits**	**Work Under Supervision**	**Project**	**Evaluation**
Number of Hours:				At least 6 hours			
Name of the class							
Professor Incharge							
Place of the Activity							

General Objectives:

This module will set the bases and standardize concepts of agroecology, agroforestry and natural resources, since it will be from them that we will develop the following ideas that will be discussed through the course. On the other hand, it is very important to develop awareness and critical thinking in the participants through understanding the results of conventional agriculture and its externalities at the global and local level.Moreover, understand how ecosystems work and our role in it, and how we can create a balance between production and nature.

This course includes these topics:

Ecosystems

- **Ecosystems and Agroecosystems:** Transformations, similarities, differences. It could use the *"Diagram of the relationship between human Invertvein and Biodiversity"by Marc Mc Leab*
- **Conventional Production and Environmental Degradation:** Homogenization of crops in the world and humans eating habits. Emphasized in the Dominican Republic environmental degradation. Case Study: Sugar Cane in the DR.

Agroforestry

- **Current global and local agroforestry systems:** What they are, how they work, advantages and disadvantages
- **Future and perspectives of Agroforestry** at the global and local level

Natural Resources

- **Importance of Agrobiodiversity as resilience strategy for climate change:** Importance of all the products that come from nature as well as people's daily life consumption/medicine/ etc. Emphasize diversity of seeds,plants,etc.
- **Environmental Services (Forest), Biophysical Components (water flow, topography, farm seize, distance to market,and other) and Biochemical cycles:** Carbon sequestration by the forest, flood control and erosion, biodiversity conservation,etc

Specific Objectives:

Give the participants the basic concepts to develop a critical opinion regarding their position in the ecosystem and in their work as future professionals within the sustainable production of cocoa (agroforesters). Knowledge about ecosystems processes, natural resources, and agroforestry systems. Understand that agroforestry is not that complex and it is the balance between agriculture and nature. Participants will be able to interpret not his/her surroundings by developing observational skills as well as questioning perceptions and perspectives.

Work Under Supervision: Activity of Environmental Awareness through simplified Cause-Effect relationship and Add Thought in simple systems thinking where other agents are incorporated. Not only the elements but the interaction and connectivity of the elements as well as the overall view (big picture).

Team work: ?

Field Trip: Descriptive observational analysis of the area visited from macro to micro, different agents: social, cultural, environmental, biophysical, etc.

Individual Reflection: After the field trip, write about what you have seen and your reflection on it.

MODULE 2

Cocoa in Agroforestry Systems	**Duration:** 4 Weeks	**Professor in Charge of the Module:**					
Basic concepts of Ecosistemas, Agroforestry and Natural Resources	**Face-Face Class**	**Virtual Class**	**Tutorial**	**Field Trip**	**Work Under Supervision**	**Project**	**Evaluation**
Total Number of Hours:				At least 10 hours			
Name of the Class							
Professor Incharge							

Place of the Activity							

General Objectives:

Develop scientific and theoretical knowledge in the functioning, integrated management in agroforestry systems as well practical knowledge in methods of soil and water conservation within these systems.

In this module, students will also learn through group work and field trips to experimental plots of Cacao Forest and other cocoa plantations in the region. In addition, there will be emphasis in developing skills and hands-on experience that will help the participant to do a farm diagnosis with a broader perspective, connect with the farmer in a more holistic way to understand the local reality and the current situation of cocoa production.

Soil Use and Conservation

- Soil factors and types of Agricultural soils in the Dominican Republic
- Soil microbiology and Trophic level (Simple/Basic)
- Soil Erosion (Processes and Control)
- Water Conservation practices (permanent and temporary- improved fallows,alley cropping,bioengineering structures,etc)

Integrated Crop Management

- **Associated crop to Cocoa:** Crops or trees that are common to associate (traditionally), Crops/trees that can be associated for a better farm´s economy and food security. How they can be managed according to time,space,nutrients,etc
- **Integrated Farm management:** Basic vegetable production (Biointensive), Agro Silvo-pasture systems (small animals for cacao plantations)

Integrated Pest Management

- Preventive Actions, Cultural control, direct control
- Natural Protection of crops and forest (Practical information and how it is done in the D.R.)

Design and Management of Agroforestry Systems

- Natural Succession of species, association and rotation of short cycle crops (planting density and shade)
- Planification, design and monitoring of agroforestry systems considering various factors, purposes and benefits (Include Cacao Forest Prototypes and experiences)
- Implementation of agroforestry systems (Use of GIS or other program)
- Monitoring and Evaluation of Agroforestry systems (Indicators)

Farm Diagnosis

- Overall/General farm analysis (Integrated baseline or Rich Picture)
- Identify and understand the needs and problems of the farmer (Holistic Method)
- Analysis, evaluation and implementation of Renovation and rehabilitation of cocoa plantations (diagnosis of canopies)
- Promoting good practices in post harvest of cocoa
- Fertilization Cacao (microbial and organic bio-fertilizers, biol, vermicompost, compost- Practice)

Specific objectives:

Participants will have the knowledge about methods to conserve water and avoid soil erosion, develop capacities to plan,design, monitor, and establish appropriately agroforestry systems (Cocoa) taking into account geographical,social,environmental factors,etc. Integrated farm analysis and sensiblization to farmers needs and realities by incorporating a holistic view of the system. Moreover, participants will be exposed to hands-on experience by doing interviews with farmers and creating a project about closing loop production, efficient ways to combine different elements to produce better.

TEACHING METHODS:

Work Under Supervision

- Practical workshop in Fertilization of Cacao (production of compost,Bio-fertilizers,etc)
- Creation of a guide questionnaire for the interview with the producers that allows them to investigate in detail the characteristics of the management of the crop in the field.

Team work: After visiting the farm and doing a diagnosis the group will be able to create a project about closing loops in the production with the different elements from the farm (Design of an efficient agroforestry system)

Field Trip: Visit different Cocoa Agroforestry Farms

MODULE 3

Cacao in Agroforestry System	**Duration:** 2 Weeks						
Economics of Agroforestry regulations, policies and certifications	**Face-Face Class**	**Virtual Class**	**Tutorial**	**Field work**	**Work Under Supervision**	**Project**	**Evaluation**
Number of Hours:				At least 6 hours			
Professor Incharge							
Place of the Activity							

General Objectives:

Impart knowledge in agricultural economy, production cost, and commercial flow. As well as the overall economy of agroforestry systems that incorporates diversification of products. Learn about regulations,policies and organic certification of cocoa in the Dominican Republic. Promote awareness of the participants not only of the potential of the Dominican

Republic as an organic cocoa producer but also to have a vision of the future with other products within the agroforestry of cocoa. Participants will be able to do a quick market analysis for products in agroforestry of cocoa.

Topics include:

Agricultural Economics and Agroforestry of Cacao

- Production cost and benefits, commercial flow of local and international markets (Case; Cacao forest)

Use of agroforestry products

- Marketing of agricultural and agroforestry products (derived from agroforestry of cocoa-post-harvest,collection, distribution,sale processes, marketing strategies and analysis,etc)

Regulations and Policies of Cocoa in the International Market

- Regulation and Policies

Organic certification of Cocoa in the DR *(Guest lecture: Valrhona, Minister of Agriculture-Organic Section)*

- Requirements,advantages, disadvantages and process.
- Traceability of Cocoa (How to do it, cross contamination, off farm impacts and influences, how is it done in other products,etc)

Environmental Services (Forest) that can bring revenue to the farm

- Carbon Credits, conservation of biodiversity,etc

Specific Objectives

Knowledge in the total valorization of cocoa production under agroforestry systems, cost of production, flux of cocoa in the national and international market. Analyze the possible products that are in the cocoa agroforestry system.Get to know and use applied technology in agroforestry. Knowledge about regulations, policies and organic certifications in the cocoa production.

TEACHING METHODS

Work Under supervision: Calculate the cost of production of a typical finca in the DR?

Group work: Develop a market analysis for a project in possible byproducts/products of agroforestry of cocoa

Field trip:

MODULE 4

Cocoa in Agroforestry Systems	**Duration:**2 Weeks						
Cocoa Industry and Entrepreneurship	**Face-Face Class**	**Virtual Class**	**Tutorial**	**Field Trip**	**Work Under Supervision**	**Project**	**Evaluation**
Number of Hours:				At least 10 hours			
Professor Incharge							
Place of the Activity							

General Objectives:

Expand knowledge about the cocoa industry in the Dominican Republic and develop the spirit of entrepreneurship in the participants.We will visit the cocoa processing industries where participants will learn about the entire process of industrialization of cocoa and valorization of by-products such as cocoa liquor,etc. As well as about the attributes and quality of cocoa. Participants will be able to understand and analyze how each step of the production, processing and distribution can influence the quality of the final product.

This course includes this topics:

Cocoa Production chain

- Description of the cocoa value chain
- Management of post harvest of cacao
- Attributes of cocoa in the DR (Fino y Aroma/Define and anchor with positioning)

Processing of Cocoa

- Processing of cocoa and the different by products (Denomination of Origen)
- Sensorial Analysis of Cocoa

Entrepreneurship in Agroforestry

- Qualities of an entrepreneur (teamwork , leadership, emotional intelligence, communication skills)

- Planificacion and design of entrepreneurship project (Practical Project)

Specific objectives:

Capability to analyze/identify cocoa quality, knowledge about the processing of cocoa, different industries in the DR, the potential of cocoa not only as a raw material but as a final product and derivatives

They have developed capacities to establish productive enterprises (personal, family and community) in production, transformation and marketing.

Leadership skills, and entrepreneurship through the project in small groups on some entrepreneurial initiative (1 Week: First, give tools on how to work as a team, communication, etc. then get to work)

TEACHING METHODS:

Work Under Supervision: Practical workshop of leadership (Specialist in teamwork,leadership,communicator could be invited)

Group Work: Preparation of an entrepreneurship project in agroforestry

Individual work: Introspective work about qualities that need to work to become an entrepreneur

Field Trip: View of a cocoa processing industry in the Dominican Republic (FUPAROCA)
Visit Hacienda CUFA - A farm with Agrotourism and products derived from cocoa. **Contact:**

Annex M: Case study from Cacao Forest (Example)

Technical Report on Value Chain Management of Breadfruit within the framework of the CACAO FOREST project

Breadfruit *(Artocarpus altilis)* is used traditionally as part of agroforestry systems mainly to add shade for the proper development of cocoa.Breadfruit is rich in vitamins,minerals and is a great source of carbohydrates however, very little is exported with the caribbean being the primary source *(Rovbertos-Nkrumah 2007).* CACAO FOREST project aims to promote the use of other crops associated with the cocoa plantations, since currently breadfruit gets wasted in the field.

A pilot process of direct marketing was conducted; A group of 20 farmers was created from block 8 of CONACADO that is located in Castillo- Duarte province. Some of the farmers are part of the experimental plots of CacaoForest. An economical estimation study was done to sell directly to ´´Multivegetales¨ company which exports breadfruit. Moreover, the study also aims to estimate the amount of available fruit that can be harvested in each farm, the number of harvesting times, the economical benefits that breadfruit can provide to the farmer and strengthen knowledge of producers about breadfruit.

Currently, farmers get paid DOP 5 per fruit by the harvester/collector while ¨Multivegetales´´ company assures DOP15 per fruit under specific characteristics that are required for the international market such as, the fruit has to be bigger than 2.5 pounds and it should not have any spots. Moreover, after harvesting it has to imminently be transported since it's highly perishable.Moreover, they are not responsible for the transportation from the farm to the collection center.

BreadFruit *(Artocarpus altilis)*

The Breadfruit tree reaches a height between 8 to 20 m with more than 60cm of trunk diameter. Produces fruits that are 10 to 20 cm wide. Breadfruit is used for human or animal consumption for its richness in energy compounds (Clement et al 1952; Cerning & Le Divich 1976). It has high carbohydrate content and it is a source of vitamin a,b,ciron and fibers (Neal 1965).

It is a perennial tree that is adapted to warm regions and is distributed throughout the Caribbean (Sauget & Liogier 1951; Bertin 2000). It has been used as a shade tree for coffee and cacao plantations in Venezuela (Herrera et al 1987). In the Dominican

Republic it has been used in the traditional agroforestry system with other crops like coffee, name, bananas,etc (Agrovoz 2019).

Methodology

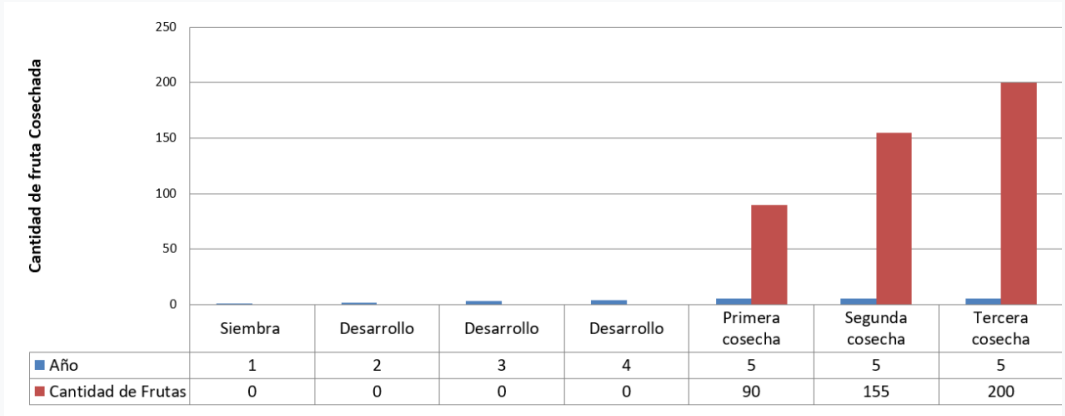
A literature review was done about the number of fruits that a tree can bear throughout the year and the number of harvest per year per plant. Moreover, a survey was done to 20 farmers from the bloc 8 of CONACADO. The survey collected information such as the name of the producer, number of breadfruit trees in their farms, and location of the farm. An interview was done to CONACADO managers to get an estimate of the transportation and handling cost. A quotation was also done to workers that harvest bread fruit in the area for labor cost estimation. Finally a route mapping was done to visualize the logistics of collecting the fruit after harvest from the different farms since the fruit has to be handled fast to the Exporter company.

Results and Analysis

1. Literature Review

Average number of fruits per plant and the number of harvesting times per year

According to literature review a single tree produces from 50-900 fruits per season, depending on environmental factors,tree size and cultivar (Lorenz & Englberger 2007, Marte 1986,Ragone 1997,2006a). There can be 3 harvest a year since the ripening of the fruit is not all at the same time (Polanco,2018).



2. Survey

A survey was done to 20 farmers where some information was recorded such as farmers´ age,number of breadfruit trees in their farms, total surface area of the farm (tareas).

Producers	Age of the farmer	Number of Trees	Farm Total Area (Tareas)
P1	65	15	80
P2	65	10	N/A
P3	62	3	102
P4	64	25	118
P5	77	3	100
P6	56	3	40
P7	41	10	N/A
P8	47	40	50
P9	62	4	N/A
P10	76	5	N/A
P11	44	1	6
P12	70	2	N/A
P13	76	4	50
P14	72	1	20
P15	70	6	50
P16	65	1	127
P17	76	2	17
P18	58	2	26
P19	66	1	23
P20	60	2	1
Total		**140**	**810**

There are 140 plants in 810 tareas (50.93 hectares) which gives a tree density of 2.7 trees per hectare with 5 farms that don't have an estimate of their farm area. Moreover, the average age of the farmers is 64 years old. Harvesting breadfruit is laborious and hard work where farmers need the physical condition to carry

Estimated cost of the possible available fruit in each farm.

The minimum number of fruits per tree is estimated to be 50 therefore the calculation was done with this number. There is a total of 6.700 fruits that could be produced by all the farmers with the tree that they already have growing.However, the calculation takes into account a 5% reduction loss of fruit per farm during harvest, post harvesting handling, and quality requirements.The total number of fruits is 6.365 that are suitable to be sold.

Finally, the total gross price per fruit is DOP 15.Therefore, there is a total gross income of DOP 95.400.However, transportation, harvesting and handling has to be taken into account (Annex 1).

3. **Interview to CONACADO and Breadfruit harvesters/collectors**

Estimated Cost of Transportation and harvesters, workers for breadfruit (Expenses)

Cost of Transportation of Bread Fruit	Quantity	Days of work	Price per unit	Cost to work (2 days)	Total Cost
Truck Driver	1	2	DOP 650.44	DOP 1300,88	DOP 1300.88
Driver´Food (Breakfast/Lunch)	1	2	DOP 250.00	DOP 500	DOP 500
Gallons of fuel	3	2	DOP 212.80	DOP 638.40	DOP 1276.80
				TOTAL	DOP 3077.68

4. **Quotation for Labor Cost of Breadfruit**

Cost of Harvesters and Handling of Bread fruit	Quantity	Days of work	Price per unit	Cost to work (2 days)	Total Cost
Fruit Harvesters	6	2	DOP 6.00 (per fruti)	DOP 6700.00	DOP 40200.00
Fruit Colectores	3	2	DOP 524.55	DOP 1049.10	DOP 3147.30
Coordinator at Collection center	1	2	DOP 1678.66	DOP 3357.32	DOP 3357.32
COOPNACADO Coordination Work	1	2	DOP 1342.85	DOP 2685.70	DOP 2685.70
Cacao Forest Field technician	1	2	DOP 1727.30	DOP 3454.60	DOP 3454.60
Workers Food (Breakfast/Lunch)	3	2	DOP 250.00	DOP 500.00	DOP 1500.00

TOTAL DOP 54344.92

The total cost of transportation, harvesting, and handling of bread fruit is ***DOP 57422.60*** which is shared within the farmers according to their number of trees. The number of harvesters and collectors was calculated with information that was provided by the exporter company. As we can see there are people that are specialized in harvesting bread fruit since the fruit can be easily bruised while harvesting which makes it not marketable. Moreover, it is common in the Dominican Republic to pay for people's daily stipend for food in this type of work which is temporary. There are two coordinators: Coordinator at Collection Center, who is responsible for receiving the breadfruit and placing them in a suitable place within the CONACADO Cooperative until the fruits are removed by the buyer (the exporter).The coordinator of COOPNACADO is responsible for the economic part to distribute the money from the sale to the producers.The number of gallons was also estimated by the driver after showing him the map of route.

Economic Benefits

The total revenue will vary between farmers because of the number of trees in each farm (Annex 2).Moreover, the cost of transportation,harvesting and handling is shared between all the farmers to lower the cost.

TOTAL GROSS INCOME	TOTAL EXPENSES	TOTAL REVENUE
DOP 95400.00	DOP 57422.60	DOP 37977.4

The revenue per fruit will be **DOP 5.67** taking into account that the tree will produce at least 50 fruits per tree and 5% is lost in the harvesting process.It was also estimated with 30 fruits per tree, which will be a total revenue of DOP 4.15 per fruit which means the cost of harvesting,transport and handling increases (Annex 3).

5. **Mapping the location of the farms and route options**

(Develop a strategy to minimize distance but maximize the number of farms reached)

6. **Questions for students**

- **What could be a possible solution for the problem?**
- **How could breadfruit be more profitable?**
- **How could the farmer get more revenue from the harvest?**

Annex N: Lesson plan example with 5E methodology

5E Lesson Template

Lesson Objective: Students will learn about…….. *Write the main objectives of the lesson*
Materials:

Engagement Phase (Time: XX) • This could involve a short video, a game,etc (Something that could capture the students' attention, stimulate thinking and help them access prior knowledge) • Create interest and excitement for your students • Asks questions and probes their initial conceptions
Exploration Phase • Enable students to explore ideas alone and in groups. • Give time to think, plan, investigate and organize information. • This is when student's experiences connect with the topic
Explanation Phase • Students acquire opportunities to connect their previous experience and make conceptual sense of the main ideas of the topic being studied
Elaborate Phase • Students expand their thinking and knowledge of the topic by creating a project

• Studentsapply or extend previous introduced cenocets and experiences to new situations • Applying knowledge to new skills
Evaluate Phase • Students and instructor review and assess what they have learned

Annex O: Methods that could be used for learning and teaching strategies

Methods and Experiences	**Questioning as teaching method**
● Lectures and presentation ● Group discussion ● Brainstorming ● Demonstration ● Exercise and problems ● Case Study Analysis ● Games ● Practical exercise ● Project work ● Field Visits	● Stimulate creative thinking by questioning ● Brainstorming (learn to respond quickly and freely)
Teaching/Learning Methods	**Learning Materials**
● Multidisciplinary seminars ● Guest Speakers ● Problem- Oriented Workshops (real world problems) ● Observers and participants in industrial processings ● Farm based practical exercises (Understand complexity of farmers' reality, decision ,aking and strategies ● Role playing to create self awareness ● Student seminars (presenting)	● Audio-Visual aids ● Posters, photographs, figures,illustrations,charts, tables,etc ● Handouts ● Computer based learning materials and programs (GIS, shademode,etc) *Rudebjer, Per & Taylor, Peter & Castillo, Romulo. (2001)*

Annex P: Next steps for the success of the program (Plan de Accion)

	PLAN DE ACCIÓN PARA EL DESARROLLO Y EJECUCIÓN DEL CURRÍCULUM					
Coordinador General:						
	Que?	Como?	Con que?	Cuando?	Quien?	**Coordinador Específico:**
Desarrollo Contenidos de Clases	Revisar el Curriculum una vez más con todos	Reunión para establecer responsabilidades y deadlines			Profesores ISA, UNEV,UASD, Cacao forest, ISARA	
	Elegir qué módulo va hacer cada universidad, que plataforma virtual se usará, donde se comparte los documentos?	Reunión para establecer responsabilidades y deadlines			Profesores ISA, UNEV,UASD,UAFAM	
	Desarrollar por contenidos de cada clase	Dar a los profesores un tema por desarrollar			Profesores ISA, UNEV,UASD,UAFAM	
	Revisar los contenidos que están compaginados entre ellos (base agroecológico)	Leer los contenidos para ver si hay concordancia				
	Estudios de Casos	Infografía de Estudios de caso Resumen	Online		Maria Fernanda Cevallos	
Plataforma Virtual	Elegir la plataforma virtual + poner el contenido					
	Finalizar quien va enseñar qué y como					

	(Online + Presencia)					
	Establecer fechas exactas para los Oradores Invitados					
Planificación	Establecer fechas del Diplomado					
	Organizar y establecer la logística del diplomado (salidas,etc)					
	Presentar costos del Diplomado					
	Presentar costos|logística para estudiantes extranjeros					
	Flyer Publicidad de promoción del Diplomado					
	Promocionar el Diplomado (Un mes de anticipación)					
	Inscripciones y pagos de los estudiantes					
	Impartir el Diplomado					
Ejecución	Dirección del programa en vigencia (Dar seguimiento a los estudiantes y su aprendizaje)					
Evaluacion	Al final del programa evaluar el diplomado por parte de los estudiantes					
	Evaluar el programa a nivel estructural,etc			Después del primer programa		

Annex Q: Certificate programs in the Americas

Link	Title	Name of the School	City-Country	Type of Education	Educative tools use	Duration	Language	Agroecological Zone	Other	Target Audience
https://docplayer.es/170505513-Programa-del-diplomadB9:F13o-en-agroforesteria-integrado-en-bachillerato-general-gobierno-de-la-republica-de-el-salvador-fondos-del-milenio.html	Programa Del Diplomado en Agroforestería Integrado en Bachillerato General	Ministerio de Educación-MEGATEC	El Salvador	Tenico	N/A	24 months	Spanish	Tropical	In Schools	Estudiantes de Colegio Tecnico
https://elti.yale.edu/events/agroecologia2021	Curso Corto en Línea: AGROECOLOGÍA Y SISTEMAS AGROFORESTALES	Yale-School of Environment (ELTI-Environmental Leadership & Training Initiative)	New Haven, Connecticut	Curso Corto	Acceso a videos, lecturas, discusiones, tareas y otros materiales que le permitirán aprender a su propio ritmo	1 month & 1 week (project o opcional)	Spanish	N/A	Online	General Public

https://dcs.unach.mx/index.php/component/k2/item/6204-oferta-unach-curso-diplomado-de-titulacion-sistemas-agroforestales-innovacion-y-transferencia-de-tecnologias	CURSO DIPLOMADO DE TITULACIÓN, SISTEMAS AGROFORESTALES, INNOVACIÓN Y TRANSFERENCIA DE TECNOLOGÍAS	Universidad Autónoma Chiapas	Mexico	Diplomado	N/A	7 Weeks	Spanish	N/A	Online Theory-Practice in the Field	Students with basic in Agronomy
http://ec.espol.edu.ec/detalle/664-Internacional-de-Cacao	Diplomado Internacional en Cacao	ESPOL (Aliado con MOCCA/CATIE)	Ecuador	Diplomado	Webinar, Practicas en campo, laboratorio, aprender haciendo, estudios de caso	140 Hours (3 months)	Spanish	Tropical	Online Theory-Practice in the Field	Student with a Bachelor

https://www.untrm.edu.pe/resoluciones/2021/Consejo/R.C.U%20N055-2021.pdf	Diplomado virtual practico: "Agronomia, Agroforesteria, Reovacion y Rehabiliacion, y Calidad para la produccion sostenibe del cacao"	UNTRM (Universidd Nacional Toribio Rodriguez de Mendoza de Amazonas)	Chachapoyas-Peru	Diplomado	https: toolbox.coffeeand climate.org/tools/habitaapp-shade-measurement-tool/)- Visita a ensayos de fermentación para abordar temas de beneficiado del grano, visita a chocolateras/industriales locales (Temas de Industrialización). Kit de materiales para manejo de cacaotales Densiometros ópticos, hipsometro láser (medir altura de árboles). Múltiples experiencias de varios países.	120 hours (50% online 50% practical)	Spanish	Tropical	On campus / Online	Students with Bachelor

https://presencia.unah.edu.hn/noticias/curla-inaugura-diplomado-sobre-produccion-de-cacao-bajo-sistemas-agroforestales/	“Diplomado sobre producción de cacao bajo sistemas agroforestales”	Centro Regional Universitario del Litoral Atlántico (CURLA)	Nicaragua	Diplomado			Spanish	Tropical	On Campus	Producers & Young Students
http://www.fhia.org.hn/descargas/noticias_fhia/2020_Noticias_de_la_FHIA_158.pdf	"Diplomado de Producción en Cacao en Sistemas Agroforestales"	Proyecto CAHOVA y en colaboración con la FHIA	Honduras	Diplomado	Webinar, Practicas en campo	84 hours (Videoconferencia)/ 78.5 hours (Field work)	Spanish	Tropical	On campus /Online	people who are members of associative companies (Producers, professionals)
https://altiplano.uvg.edu.gt/ingenieria/agroforestal/doc/pensum-tecnico-agro.pdf	TECNICO Universitario en Agroforesteria (ALTIPLANO)	Universidad del valle de Guatemala	Guatemala	Tecnico	N/A	2 Anos (24 meses)	Spanish	Altiplano	On campus	Estudiantes de Colegio Tecnico
http://upinforma.com/nuevo/info.php?cat=noticias&id=5071	TECNICO EN AGROFORESTERÍA	Extensión Universidad de Ocu	Panama	Tecnico	N/A	2 anos (10 monts)	spanish	Tropical	On campus	Estudiantes de Colegio Tecnico

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universitet