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AGRICULTURE & INNOVATION



# **EIP-AGRI Focus Group** Climate-smart (sub)tropical food crops in the EU

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## Introduction

Agriculture in the outermost regions of the EU<sup>1</sup> is mostly oriented toward exports of products such as **sugarcane and banana**. These are produced as **monocultures**, which are more sensitive to pest, disease and **threats posed by climate change** (Debaeke et al., 2017<sup>2</sup>). Such monocultures require thus **large quantities of external imported inputs** and are **highly subsidized**. At the same time, these EU outermost regions are generally very dependent on **imported food**, especially on livestock products and processed food such as milled products and beverages (POSEI report, 2015). Agricultural trade balance shows a large deficit as most outermost regions import more than they export and face a drastic competition of neighbouring countries on the market (such as Suriname and Brazil for French Guyana).

More diversified farming systems still cover a large part of the agricultural area in the EU-outermost regions (Stark et al., 2016<sup>3</sup>). Still, these diversified farms represent up to 80% of the farms in the territory with an average size under 10 ha for most outermost regions (Posei, 2016). The proportion of diversified systems as regards to monocultures highly depends on the outermost region considered, in La Réunion 57% of the UAA is dedicated to sugarcane whereas in Mayotte, monoculture represent only 16% of UAA. **Diversified systems, such as agroforestry or mixed crop-livestock systems**, adapt better to local conditions and are potentially more environment-friendly and resilient to climate change. They can also produce a wider range of different foods, from staple crops, to fruit and vegetables, as well as animal products. Market gardening, tuber, fruit or pig and poultry production **targeting the local market** are successful diversification options and do not currently meet local demand. However, these diversified systems, which include **traditional subsistence/small-scale farming**, are hampered among others by product safety demands, production costs and few agro-industrial options for processing. Furthermore diversified systems are known to be **work-intensive and complex to manage**. Such **knowledge-intensive systems** require specific training options.

Moreover, (sub)tropical crops are of high interest for continental EU as well, as they can be **relevant options in the climate change** context. Climate change and the resulting changes in temperature and precipitation may bring further changes in land suitability and crop choices in continental EU. In this context, (sub)tropical crops are key to the **"Farm to Fork" Strategy**<sup>4</sup>, part of the European Commission's Green Deal. The **European Green Deal** is aiming to transform the EU into a resource-efficient and competitive economy with no net greenhouse gases emissions by 2050 and where economic growth is decoupled from resource use. The "Farm to Fork" Strategy considers in particular 'the ongoing transformation of food systems worldwide and the goal of making Europe's food system the gold standard for sustainability'. In this strategy, **(sub)tropical crops, both in outermost regions and continental Europe**, are thus of interest as options to promote **more sustainable and resilient production systems** (other than mono-cropping systems), that may be **better adapted to the challenges posed by climate change**.

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<sup>1</sup> The European Union (EU) counts nine outermost regions, which are geographically very distant from the European mainland but an integral part of the EU. These are French Guiana, Guadeloupe, Martinique, Mayotte, Reunion Island and Saint-Martin (France), Azores and Madeira (Portugal), and the Canary Islands (Spain).

<sup>2</sup> Debaeke P. et al. (2017). Climate-smart cropping systems for temperate and tropical agriculture: mitigation, adaptation and trade-offs. Cah. Agric. 2017, 26, 34002.

<sup>3</sup> Stark F. et al. (2016). Crop-livestock integration, from single practice to global functioning in the tropics: Case studies in Guadeloupe. European Journal of Agronomy 80, 9-20.

<sup>4</sup> <https://www.ifpri.org/event/european-green-deal-farm-fork-strategy-sustainable-food>

## Objectives of the Focus Group

This Focus Group aims to increase **understanding of current farming practices for (sub)tropical crops** and to **facilitate knowledge and innovation exchange** on these practices between farmers, researchers, farm advisers and other relevant actors in the EU continental and outermost regions. The Focus group will concentrate on **options for (sub)tropical crop diversification as a climate-smart option**, including agroecology, agroforestry and mixed crop-livestock production systems to make them economically viable and more resilient to climate change.

We will consider two main levels: i) identifying and assessing the adoption of **farming practices** that increase the sustainability and resilience of farming systems, especially in a climate change context, and ii) identifying the options for the development of **innovative value chains** including circular economy. Both conventional and organic sectors will be considered. Such axis are core to the The "Farm to Fork" Strategy, part of the European Commission's Green Deal, to respond to climate change challenges along the food chain.

The Focus Group will carry out the following main tasks:

- Provide an **overview of current farming practices** in (sub)tropical crops, both for conventional and organic systems.
- Identify the **challenges and opportunities toward the adoption** of such farming practices in EU outermost and continental regions.
- Propose **innovative, climate-smart, cost-effective farming practices and business models** relying on the efficient use of local resources and strengthening the local economy, and analyse factors influencing farmers' perception and decision-making
- Discuss the **adoption potential** (enabling and limiting factors) of those innovative farming practices of (sub)tropical crops in the EU outermost and continental regions.
- **Identify and list research and innovation needs**, and provide ideas for Operational Groups and other innovative projects.

## State of play

### a. Framing key issues

#### Agriculture in outermost regions of EU

The agriculture of outermost regions of the EU is mostly oriented toward **exports of highly subsidized agricultural products**, that are largely dependent on external inputs. Monoculture, and (sub)tropical monoculture crops in particular, have been highlighted for their negative effects on soil quality, biodiversity and water management (Debaeke et al., 2017<sup>5</sup>).

<sup>5</sup> Debaeke P. et al. (2017). Climate-smart cropping systems for temperate and tropical agriculture: mitigation, adaptation and trade-offs. Cah. Agric. 2017, 26, 34002.

Key numbers on agriculture in the outermost regions of the EU are described in Table 1.

Table 1: Key numbers on agriculture in the outermost regions considered (except Saint-Martin). Source: POSEI, 2016.

OR	Guadeloupe	Martinique	Guiana	La Réunion	Azores	Madeira	Canary Islands	SAI North Region	SAI South Region
1. UAA (ha)	30 960	24 170	29745	42 200	118590	5 260	52 210	168 610	106 080
2. N° of agricultural holdings	6 976	2 994	5 912	7 651	13540	13 610	14 170	29 662	21 088
3. Employment (AWU)	7 795	7 050	6 880	11 657	11532	13 220	22 140	15 910	9 960
4. Farm labour force (persons)	12 990	8 850	8 250	15 970	27 702	30 770	41 880	50 150	36 440

## Farming systems and (sub) tropical crops in outermost regions

The agricultural systems are very different from an outermost region to another. For instance, the proportion of diversified systems as regards to monocultures highly depends on the outermost region considered. The main productions are diverse according to the region considered with a predominance of **banana and sugarcane** in Guadeloupe and Martinique, **sugarcane** in La Réunion and **cassava and rice** in French Guiana mainly for local consumption and on savannas rainfed along the coast. In Guadeloupe, banana production represents 8% of arable lands, sugarcane around 40%, and all other crops occupy nearly 40%, and uncultivated lands for 12%. In Martinique, proportion of arable lands cultivated with banana is around 27%, whereas sugarcane is not as important.

In la Réunion, **monoculture of sugarcane** is the main production (57% of UAA). **Key vegetable** are tomatoes, salad, potatoes while pineapple is the most cultivated fruit. Good establishment of animal production chains, organized around cooperatives, is favouring local production and consumption of livestock products. In French Guiana, **agroforestry** has kept there large importance and farmers tend to limit the use of chemical inputs. In Mayotte, agricultural products are not exported as more than 95% of farms are small multi-activity farming and there is widespread of a traditional system called "**Jardin Mahorais**", a **multi-crop production system** with **11 to 16 crops in which food crops** are combined with fruit trees, with permanent vegetable cover.

In the Canarian Islands, **fruit and vegetable production** are the main production. Permanent pastures is the main land use in Azores and Madeira. In the Azores, **banana** is the main fruit produced (216t/year); **passion fruit, anona, mango, papaya and avocado** (respectively between 3 to 4.5 tons). In the Canary Islands, the **three main crops are bananas** (exported to Spain mainland), **vineyards and potatoes**. The Canary Islands do produce a **lot of fruit and vegetable for exportation**, mainly tomatoes (uncompetitive as regards to Morocco production), and cucumbers (exported directly to Rotterdam/Southampton), sweet fruit, citrus fruit and tropical fruit such as avocado, papaya, mango and pineapple. Whereas banana and cherimoya are exported to mainland, papaya, passion fruits and pitaya are destined to the Island consumption but beginning to be exported experimentally to mainland. Table 2 is summarising the main types of crops and farming systems in outermost regions.

Table 2: Farming system description and main (sub)tropical crops in outermost regions of EU

Outermost region	Main crops	Main types of farms	Broader context/challenges for agriculture locally
<b>Guadeloupe (France)</b>	<ul style="list-style-type: none"> <li>• Sugarcane (40%)</li> <li>• Banana (8%),</li> <li>• Other crops (40%)</li> <li>• Uncultivated lands (12%).</li> </ul>	<ul style="list-style-type: none"> <li>• Smaller farms (80 %; &lt;3 ha): diversified systems (vegetables, crops, fruits, ornamentals, aromatics, livestock)</li> <li>• Largest farms (20%; &gt;100 ha): banana, sugarcane monoculture</li> </ul>	<ul style="list-style-type: none"> <li>• Banana production mainly for export to mainland market</li> <li>• Production/commercialization well organized</li> <li>• Over the last decade, direct commercialization increased</li> </ul>
<b>Martinique (France)</b>	<ul style="list-style-type: none"> <li>• Banana (27%)</li> <li>• Sugarcane (16%)</li> </ul>	<ul style="list-style-type: none"> <li>• 29% of farms &lt; 2 ha diversified, mostly for vegetable production and livestock</li> <li>• 63% are 2-20 ha; diversified</li> <li>• 6% are &gt;20 ha but occupy 54% UAA, monocultures</li> </ul>	<ul style="list-style-type: none"> <li>• Production well organized by banana growers' organization,</li> <li>• Bankrupt of a major cooperative led producers to develop direct sales.</li> </ul>
<b>French Guiana (France)</b>	<ul style="list-style-type: none"> <li>• Cassava (42%)</li> <li>• Fruit crops (9%)</li> <li>• Other crops for auto-consumption (ride) (11%)</li> </ul>	<ul style="list-style-type: none"> <li>• 80 % family-farms traditional itinerant manual agriculture; subsistence slash-and-burn cultivation, practiced by women - 5 400 farms</li> <li>• 20% mechanized commercial farming (on the coastal strip) - 600 commercial farms.</li> </ul>	<ul style="list-style-type: none"> <li>• Agriculture booming (+20% UAA on 2010-2016) to cover the growing needs of food linked to demography</li> <li>• Lack of processing facilities to favour local self-sufficiency in food (such as milling industries, slaughterhouses)</li> </ul>
<b>La Réunion (France)</b>	<ul style="list-style-type: none"> <li>• Sugarcane (57%)</li> <li>• 24,336 ha</li> <li>• Fresh vegetable (4%)</li> <li>• Fruit production (6% - pineapple and banana)</li> <li>• Forage (3%)</li> </ul>	<ul style="list-style-type: none"> <li>• 46% of farms producing sugarcane, as monoculture with 10% of UAA for diversification.</li> <li>• Decline in traditional production of geranium and vanilla led to development of fruit and vegetable, meat and egg production</li> </ul>	<ul style="list-style-type: none"> <li>• Sugarcane as 1<sup>st</sup> industrial economic activity.</li> <li>• Agriculture diversified for 20 years - import-substitution logic for animal industries</li> <li>• Increasing tensions for land-use (housing, infrastructure, transport and agriculture)</li> </ul>
<b>Mayotte (France)</b>	<ul style="list-style-type: none"> <li>• "Jardin Mahorais" 4 to 16 crops on field with trees</li> <li>• 8% of farms produced tomato, eggplant</li> </ul>	<ul style="list-style-type: none"> <li>• Associated crops represent 84% of growing area</li> <li>• 16% for monoculture</li> <li>• 87% of growing area have trees).</li> <li>• Irrigation is low and an issue</li> </ul>	<ul style="list-style-type: none"> <li>• Most of the production for family food (80% of farms). Only 60% of farms sold their production</li> <li>• Fruit and vegetable are sold through direct sales, mass distribution and cooperatives</li> </ul>
<b>Canarian islands (Spain)</b>	<ul style="list-style-type: none"> <li>• Banana (17%)</li> <li>• Vineyards (12%)</li> <li>• Avocado (3%)</li> <li>• Citrus (2,5%)</li> <li>• Mango (1%)</li> </ul>	<ul style="list-style-type: none"> <li>• Environmentally friendly with no or very limited use of pesticides</li> <li>• No traditional combined use with livestock</li> </ul>	<ul style="list-style-type: none"> <li>• Import of (sub)tropical fruits not allowed to the islands, most of production consumed locally.</li> <li>• Exception is banana and avocado exported to mainland</li> </ul>
<b>Azores (Portugal)</b>	<ul style="list-style-type: none"> <li>• Mostly pasture and corn for cattle feeding</li> <li>• Banana</li> </ul>	<ul style="list-style-type: none"> <li>• Specialised farms based on intensive to semi-intensive milk and meat production</li> <li>• Other farms dedicated to subtropical fruit species normally focus on selling</li> </ul>	<ul style="list-style-type: none"> <li>• Fruit marketing chains : proximity and short (3 actors)</li> <li>• Main current problem: channelling of excess production of bananas (lost; deposited in landfill or fed to animals).</li> </ul>
<b>Madeira (Portugal)</b>	<ul style="list-style-type: none"> <li>• Subtropical crops (12%) sugarcane, ...</li> <li>• Subtropical fruits (15%) banana, mango, passion fruit, taro</li> </ul>	<ul style="list-style-type: none"> <li>• Traditional subsistence/small-scale farming side-by-side (57%) with some cash or commercial export or local consumption productions</li> <li>• 9,761 farms are &lt; 1ha</li> <li>• 589 farms less 5 hectares</li> <li>• 21 farms more than 5 hectares.</li> </ul>	<ul style="list-style-type: none"> <li>• Urbanization and tourism led to the abandon of agriculture areas.</li> <li>• Long distance unsustainable supply</li> <li>• All crops mainly released for the local market and consumption.</li> </ul>

Source: Agrest, Agricultural Census 2000-2010, Annual Statistics for 2014, expert homework

## Food balance in outermost regions of EU

Overall, **all outermost regions import more than they export**. The availability of land for agriculture is often limited by tourism or urbanization (Guadeloupe, Martinique, la Réunion) or topography (Azores, Canarian Islands). These regions rely in particular on imports for animal feed and by-products, cereals and flour (because of absence of milling industries). Agroindustries to process food products are particularly lacking in French Guiana whereas in La Réunion agroindustries allow to cover more of the food needs, especially for processing livestock goods. In general, channelling options are lacking to sale the products. In the Azores, for instance, only 50% of banana production is sold, whereas the other half is lost, either deposited in landfills either given to animals because of a seasonal production and lack of channelling options; anona is not consumed nor exported (4.5 tons/year). Imports of frozen meat, beverages and some vegetable, is also quite common.

In terms of agricultural area, outermost agriculture is mainly based on small farming dedicated to self-subsistence that is often not accounted for in statistics or accountancy. Still, these diversified farms represent up to 80% of the farms in the territory with an average size under 10 ha for most outermost regions (Posei, 2016). These systems include market gardening, orchards, tuber and fruit production, pig, poultry and rabbit breeding. **Products destined for the local market do not meet local demand, and the agricultural trade balance shows a large deficit (Agreste, 2015<sup>6</sup>)**. Moreover, both livestock and crop production depend to a great extent on imported and increasingly expensive feed concentrate and mineral fertilizer.

## A focus on (sub)tropical crops in continental Europe

(Sub)tropical crops are of high interest for continental EU, as they can be **relevant options in a context of climate change** (Table 2). Tropical crops are currently grown mainly in Spain and Portugal, being the main EU producer of (sub)tropical fruits. Spain produces mainly **avocados**, with 80% of production being exported, **cherimoyas, mangos, papaya** and **sweet potatoes**. Few chemical inputs are applied thanks to the a dry climate in South of Spain. The main concern is the high **use of water for irrigation**. Only papaya is grown under greenhouse. **Pineapple and banana** remain only planted in its outermost region, the Canarian Islands. Some experimental plantings of litchi, carambola and guava are ongoing too. In Portugal, avocado is the main tropical crop produced whereas **sweet potato** is increasing too. Other (sub)tropical plants are under development such as bamboo or fruits like mango, pineapple, litchi, papaya, anona and guava. Farms producing tropical fruits in Portugal are small (less than 5 ha) and use low levels of chemical inputs. In other parts of the EU, specifically in the southern regions, the production of (sub)tropical crops is also increasing, due to a significant increase in European consumer demand in particular for avocado. As a result of high demand and prices for avocado, **orange trees are being eradicated and replaced by avocados**, highly demanding in water and labour. **Kiwi fruit** acreage and production in Europe has increased consistently. The leading producers are Italy, France, Greece, Portugal and Spain.

Climate-smart options for (sub)tropical crops may thus be relevant for continental Europe, for improving and increasing current production and rely less on imports. Furthermore, outermost regions can be seen as relevant locations for experiments on crops in the future context of climate change. Finally, tropical crops may

<sup>6</sup> Agreste, Ministère de l'agriculture, de l'agroalimentaire et de la forêt, 2015. Statistique Agricole Annuelle, Edition 2015, Données En Lignes, from <http://agreste.agriculture.gouv.fr/IMG/pdf/D97115A11.pdf>.

have an interest for renewable energy as 26% of biodiesel is imported in EU, but we do not have sufficient information about the type of (sub)tropical crops used to produce this biodiesel outside Europe, except that one third is coming from palm oil (REP, 2017).

Table 3: Main (sub)tropical crop production in continental Europe

Country	Region	Crop	Volume	Area
Spain	Andalusia/Mediterranean coast	Avocado	70 000 tons	17 158 ha
Spain	Andalusia	Mango	25 – 35 000 tons	4 722 ha
Spain	Andalusia	Sweet potato	14000 tons	665 ha
Portugal	Algarve	Avocado	4895 t	1,200 ha
Portugal	Algarve	Citrus Fruits	42 000 t	21,000 ha
Portugal	Aljezur region	Sweet potato	54 000 t	3,000 ha
Portugal	mainland	Peanut	2500 t	500 ha
Greece	Crete	Avocado	6 630 t	1657 ha
Greece	mainland	Kiwi	100 000 t	3330 ha
Greece	mainland	Sweet potato	2,000 t	110 ha
Italy	Sicily	Avocado	n.a.	260 ha
Italy	Mainland	Kiwi	370 000 t	12 333 ha
Italy	Mainland	Sweet potato	12000 t	667 ha
France	Mainland	Kiwi	75 000 t	2500 ha

## b. Good practices - Potential solutions for climate-smart tropical crops

Recent reviews have in fact highlighted three relevant levers for climate-smart crops in the tropics: i) **limiting N<sub>2</sub>O, CH<sub>4</sub> and CO<sub>2</sub> emissions**, ii) **storing more carbon** and iii) **developing green energy production**, through methanisation or agrifuels. According to Debaeke et al. (2017), diversification with legumes would allow limiting mineral N input and thus N<sub>2</sub>O emissions. Such climate-smart solutions for (sub)tropical crops already exist in the outermost regions of EU as well as in continental EU.

Three main levels of analysis are relevant to consider sustainable (sub)tropical crops:

- i) the **plant level** with **breeding resistant varieties** to pest and climate change,
- ii) the farm level considering the diversification of the **cropping systems**, including **conservation agriculture or agroforestry** practices or **integrating livestock, and**
- iii) **the landscape level**, considering the integration of farming practices in the territory, which implies for instance collaboration between neighbouring farmers to favour local autonomy in inputs, etc.

At the cropping system level, short-term strategies have been identified such as **shifting sowing dates, changing species, cultivars and crop rotations**, modifying **soil management and fertilization**, introducing or **expanding irrigation**. Adapting irrigation and drainage during mid-season would allow reducing CH<sub>4</sub>. Then, to store more carbon in soils, **conservation agriculture** includes a set of sustainable practices such as no-tillage, sowing cover crops, mulching, and finally introducing or maintaining grasslands. The potential of **agroforestry with low tree density and hedges** in temperate and tropical contexts has been highlighted in several studies (Aertsens et al., 2013<sup>7</sup>). Finally, **including livestock into the cropping system** is proven to be a strong lever to **allow crop diversification**, valorise **local and rustic varieties** and in particular **leguminous crops** that can be grown pure or mixed with other crops<sup>8</sup>. Livestock is key in outermost regions where the production is not covering the local needs for food.

Some examples of (sub)-tropical crops are relevant for continental Europe as well. Diversification options are considered in Portugal, such as a hyacinth bean (*Lablab purpureus* (L.)), a multipurpose leguminous plant fixing nitrogen and developing dense soil coverage allowing weeds suppression, lower evapotranspiration and erosion control. This crop is adapted to extreme drought conditions through its extensive root system, salinity tolerant, and adapted to a wide range of soil types. When this **leguminous** is used intercropped with temperate/Mediterranean crops, allows decreased fertilization, water needs and soil salinity. Successful field tests have implemented it into tomato fields and olive orchards intercropping. In Portugal, agroforestry systems are seen as a key strategy for marginal land-use and prevention of uncontrolled fires by eliminating fuel-potential ground covers and creating green corridors. Dry-fruit production could thus be considered. Another example is the operational group BDMIRA, trying to adapt sweet potato production in Portugal's mainland (Box 1). **Sweet potato** is also being adapted to Northern France conditions.

### Box 1: BDMIRA: A project to improve the varieties of sweet potatoes in Portugal

Sustainable and competitive sweet-potato at Mira irrigation zone: innovative practices and organizational dynamic

This project is led by researchers at the Uniav, the Portuguese institute for agronomy and veterinary research. The aim is to **increase the productivity of the variety of sweet potatoe 'Lira'** in Mira Irrigation Perimeter (PRM). Their idea is to encourage nurserymen and producers to follow a production model / organizational dynamics relying on a new innovative technology for the propagation of plants free of virus and other diseases, and production and conservation technologies better adapted to soil and climatic conditions and production system.



<sup>7</sup> Aertsens J, De Nocker L, Gobin A. 2013. Valuing the carbon sequestration potential for European agriculture. *Land Use Policy* 31: 584–594.

<sup>8</sup> Dumont B, Ryschawy J, Duru M, Benoit M, Chatellier V, Delaby L, Sabatier R. 2019. Review: Associations among goods, impacts and ecosystem services provided by livestock farming. *Animal*, 13(8), 1773-1784. doi:10.1017/S1751731118002586



At the farm level, **integrating livestock** such as small ruminants or poultry in the systems would allow such diversification in particular to maintain or insert grasslands, and provide new food and feed sources, while using crop residues and fertilizing (Stark et al., 2016 – *maybe add a box on an example of farm experiment here*). Livestock would allow more options for green energy as well (recycling manure and slurry for methanisation, ...). Still, integrating new crops or livestock may have a great impact on supply chains locally as new markets would be needed. For instance, legumes that would be inserted into crop rotations may be either converted to food (chickpea, ambreve) or rather used to feed animals (alfalfa, ...).

All these **agro-ecological options** are allowing to achieve a **satisfying compromise between food production, adaptation and mitigation to climate change**, thanks to new biological regulations that have emerged in such low-chemicals and diversified cropping systems (Debaeke et al., 2017). A multilevel approach has already been developed through a participative approach in the Operational Group VALAB led in Guadeloupe (Box 2). In the Canarian Islands, a farmer group has initiated a project called "Agriculture is much more" to favour circular economy through animal feeding with waste recycling, such as crop residues fed to animals locally. Finally, **moving crops to more suitable locations**, such as from outermost regions to continental Europe, has been cited as relevant in a climate change perspective (Debaeke et al., 2017).

### Box 2: VALAB: A multilevel operational group to improve vanilla production in Guadeloupe. Integrated Ecosystemic value enhancement of the Guadeloupe Forest Agrobiodiversity

The Union of Vanilla Producers of Guadeloupe advanced the diversification of farmers' productive system and its activities as a solution for the economic difficulties of vanilla monoculture and other perennial monocultures and elaborated the VALAB project. The project aims **to study the feasibility of viable small-scale farming systems that will respect the integrity of the Guadeloupean forest biodiversity**.

This multipartner project is aiming at solving the non-viability of vanilla-based monocrop. The project is involving the farmer association for vanilla, the national park of Guadeloupe, economic actors and researchers. Their method combines undergrowth field surveys, analysis of stakeholders orientations, aggregating partners around the VALAB design, participatory workshops with Syaprovag farmers (on ecosystemic services and sustainable agricultural production).



#### Discussion questions

- What are the already existing climate-smart innovations you know? At which level (parcel, farm, region)?
- In which type of farming systems do these innovations take place?  
(*polyculture, crop-livestock integration, agroforestry, conservation agriculture, intercropping, ...*)
- Are these options successful in terms of economic, environmental and social aspects? (*e.g. do they allow to limit the use of imported inputs?, ...*)

- Are there already regional projects involving multiple actors on climate-smart crops? (*such as methanisation platform to recycle crop residues, local cooperation between crop and livestock farmers, ...*)
- Are these solutions site-specific? Would these options be relevant for other regions (including continental Europe to face climate change)?

### c. Success and fail factors

#### Opportunities for developing solutions for climate-smart tropical crops

All the above-mentioned solutions should not be simple add-on technology solutions but should involve a redesign of the farming systems. Applied research on new varieties and practices should be combined to modelisation to explore new solutions. Participative research should favour knowledge exchange and capitalization on existing successful systemic options. Specific incentives would be needed to enable major changes.

#### Discussion questions

- What are the barriers and opportunities to implement such successful climate-smart options?
- What kind of business model would allow them to develop?
- What kind of initiatives would allow them to develop? Or are lacking?
- Which multipartner initiatives could be developed?

#### Innovative projects on climate-smart (sub) tropical crops

We reviewed current innovative projects on climate-smart option for (sub)tropical crops in outermost regions of EU and continental EU (Table 4). These projects were found at three different scales of analysis mentioned previously: plant breeding and adaption of varieties to climate change and new pests/disease, new cropping system itineraries and new farming systems, such as agroforestry and livestock integration. The list is not exhaustive and can be amended by the experts.

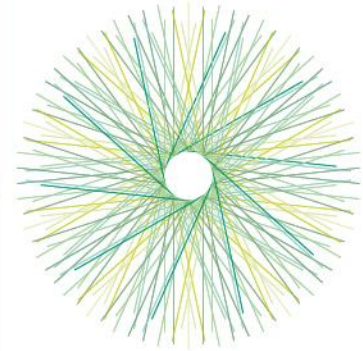
Table 4: List of relevant initiatives on climate-smart options for (sub)tropical crops

Name of the project	Type	Area (Country)	Main objective	Leader
For a sustainable and ecologically intensive banana production in Martinique	OG	Martinique (France)	Develop agro ecological alternatives of controlling black sigacoka, and reduce the use of herbicides and synthetic fertilizers and develop a multi-criteria evaluation of the sustainability, valuing biodiversity and technical-economical performance of new cropping system	UGPBAN (banana producer association)
<b>VALAB</b> Integrated Ecosystemic value enhancement of the Guadeloupe Forest Agrobiodiversity	OG	Guadeloupe (France – outermost)	Study the feasibility of viable small-scale farming systems that will respect the integrity of the Guadeloupean forest biodiversity.	SYAPROVAG (vanilla producer association),
<b>ITICan</b> Innovative Technical Cultivation in Sugar Cane: Installation of Intercrop Service Plants (Fallow) -	OG	Martinique (France)	n.a.	CTCS (Technical Institute for sugar-cane and sugar)
<b>Bioferm</b> Management of conservatory of biomasses, nutrients and soil fertility in small family farms in OGMayotte island and the transfer of information	OG	Mayotte (France)	Contribute to the sustainability of mixed agricultural production systems joining agriculture and farming animals by offering technical data to favour self-sufficiency and appropriate advice to farmers	Cirad
<b>CARISMED</b> Sustainable production of papaya in areas with a subtropical-Mediterranean climate	OG	Gran Canaria (Spain-outermost)	Diversify production with a wider range of crops (tropical fruit trees such as papaya with rapid entry into production and high yields)	Anecoop S. Coop. (local cooperative)
<b>Europapaya</b> Develop a productive model for papaya production in Spain	n.a.	Spain	Give a boost to the development and optimization of a productive model for the intensive cultivation of papayas in Spain.	Cajamar experimental station
<b>PATATASS</b> Evaluation of technical and economic potential for the integration of sweet potato crop in agrobiological and vegetable systems –	OG	Normandy (France – continental EU)	Aiming at develop recommendations to include sweet potato interesting in the context of diversification, both with vegetables and market gardeners.	Sileban (local institute for vegetable experiment)
<b>+BDMIRA</b>	OG	Mira (Portugal-	Increase the productivity of the variety	Instituto nacional

Sustainable and competitive <b>sweet-potato</b> at Mira irrigation zone: innovative practices and organizational dynamic		continental EU)	of sweet potato 'Lira' in Mira Irrigation Perimeter (PRM.	de investigação agrária e veterinária ip
Sweet potatoes (Ipomea batatas) in a strategy of agricultural diversification in the Languedoc-Roussillon region	OG	Continental EU France Languedoc-Roussillon	Aiming at testing practices to include sweet potato interesting in the context of diversification, both with vegetables and market gardeners.	n.a.
MUSA Microbial Uptakes for Sustainable management of major banana pests and diseases	H2020	Italy/Spain/Belgium	Aiming at encompassing novel IPM methods based on microbial consortia and available banana (Musa spp.) and enset (Ensete ventricosum) germplasm, including newly developed elite hybrids	CNR, Istituto per la Protezione Sostenibile delle Piante, UO Bari (Coordinator) (CNR) Italy
BREEDCAFS BREEDing Coffee for AgroForestry System	H2020	Italy (and Worldwide)	diversify the range of varieties available for this more sustainable production method.	Cirad
TROPICSAFE Insect-borne prokaryote-associated diseases in tropical and subtropical perennial crops		Spain / Italy (and worldwide)	address economically important insect-borne prokaryote-associated diseases of perennial crops (palm, citrus and grapevine) grown in tropical and subtropical areas which are seriously affecting the trade and import of agricultural products and materials worldwide.	Alma mater studiorum - universita di bologna

**Further steps to favour the development of climate-smart (sub)tropical crops**

- What knowledge/research gaps to allow/speed up the transition towards climate resilient (sub)tropical cropping systems,
- Can we add to the list below more existing operational groups, farmer knowledge platform, research projects or other project that could foster the development of climate-smart practices?
- What kind of research and innovative projects (such as Operational groups, other type of projects, open innovation initiatives) could be implemented to improve existing solutions and out-scale them?



eip-agri  
AGRICULTURE & INNOVATION

**The European Innovation Partnership 'Agricultural Productivity and Sustainability' (EIP-AGRI)** is one of five EIPs launched by the European Commission in a bid to promote rapid modernisation by stepping up innovation efforts.

The **EIP-AGRI** aims to catalyse the innovation process in the **agricultural and forestry sectors** by bringing **research and practice closer together** – in research and innovation projects as well as *through* the EIP-AGRI network.

**EIPs aim** to streamline, simplify and better coordinate existing instruments and initiatives and complement them with actions where necessary. Two specific funding sources are particularly important for the EIP-AGRI:

- ✓ the EU Research and Innovation framework, Horizon 2020,
- ✓ the EU Rural Development Policy.

**An EIP AGRI Focus Group\*** is one of several different building blocks of the EIP-AGRI network, which is funded under the EU Rural Development policy. Working on a narrowly defined issue, Focus Groups temporarily bring together around 20 experts (such as farmers, advisers, researchers, up- and downstream businesses and NGOs) to map and develop solutions within their field.

**The concrete objectives of a Focus Group** are:

- ✓ to take stock of the state of art of practice and research in its field, listing problems and opportunities;
- ✓ to identify needs from practice and propose directions for further research;
- ✓ to propose priorities for innovative actions by suggesting potential projects for Operational Groups working under Rural Development or other project formats to test solutions and opportunities, including ways to disseminate the practical knowledge gathered.

**Results** are normally published in a report within 12-18 months of the launch of a given Focus Group.

**Experts** are selected based on an open call for interest. Each expert is appointed based on his or her personal knowledge and experience in the particular field and therefore does not represent an organisation or a Member State.

\*More details on EIP-AGRI Focus Group aims and process are given in its charter on:

[http://ec.europa.eu/agriculture/eip/focus-groups/charter\\_en.pdf](http://ec.europa.eu/agriculture/eip/focus-groups/charter_en.pdf)



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