EIP-AGRI Focus Group

Climate-smart (sub)tropical food crops in the EU

MINI PAPER 1: Improvement of traditional systems enhancing agro-ecological techniques

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Introduction

Several member states of the European Union have territories in tropical or sub-tropical regions where agricultural production is important.
The agricultural production can take many forms, ranging from so-called family farming on small areas to more intensive production in organised sectors such as sugarcane or dessert bananas in Madeira, the Canary Islands and French Overseas Departments.

Small farm holdings represent a large majority of the farms in most outermost regions. There are many differences between the small-scale farms themselves, depending on the level of technicity used, the specialisation, the type of labour, etc.

Traditional crops and cropping systems in small scale agriculture are very diverse and are closely linked to the regions and its populations. However, they share a number of characteristics, such as:
- They are often run at a family level and call upon family labour,
- The cultivated area per farm is usually small (on average <1ha to 2ha),
- They are often operating on a (semi)subsistence basis,
- The use of external inputs is limited,
- Agro-biodiversity is important,
- They are mostly based on empirical knowledge,
- The traditional farm sector is generally not well structured. This hinders traditional farmers' access to financial resources and advisory services. It also limits networking and interaction amongst them.

Over time, traditional farmers have been faced with growing or new needs for food, education, health, access to new technologies, etc., and the need to increase their income to fulfil these needs.
Several avenues are open to them, including the use of a dual activity and the intensification of their agricultural system, with increased productivity, improved product quality and access to local markets and distribution channels, etc., i.e. to place their activity in a more remunerative market circuit.

In regions where family and social values are important, it is not easy to reconcile changes in the farming system with the conservation of traditional values.

This mini-paper describes several types of traditional systems found in the (sub)tropical regions of the EU, to identify the different services they provide (food, environmental, social, etc.) and to imagine ways of intensification, which, while not disrupting these services, would improve farmers' incomes and preserve the agro-ecological character of these production systems.

The traditional systems have different names depending on the region: "Abattis" in French Guiana, "Jardins créoles" in Martinique and Guadeloupe, "Jardins mahorais" in Mayotte, "Fazendas of Madeira" in Madeira, "Gavias, Gerias, Sorribas or Terrazas/Bancales" in Canary Islands, "Pomares tradicionais" in Azores.

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Dissertation

In this section, a brief description is given of four traditional systems, followed by a SWOT comparative analysis and an identification of research needs and ideas for innovative projects.

FRENCH GUIANA: Abattis-brûlis or Slash-and-burn

General description

The total agricultural area represents less than 1% of the 8.3 M ha of French Guiana. 42% of this total agricultural area is actually used (cultivated arable land, grassland, orchards). The Utilised Agricultural Area (UAA) has been growing steadily for many years. It has increased by 30% in less than 10 years to reach 33,265 ha in 2018.
50% of the 6,000 farms have an UAA of less than 2 ha and about 30% have a Gross Standard Production (GSP) of less than or equal to 15,000 € and are considered as "Very Small Farms".

As many other tropical countries, traditional slash-and-burn agriculture is still widely practiced in French Guiana, a territory still covered with rainforest on more than 80% of its area.

Slash-and-burn involves cultivating a newly cleared plot of rainforest. It is called "abattis" as it comes from the word "abattre" (i.e. "cut down" in French). French Guiana 'abattis' shares the same characteristics as in neighbouring countries. It is usually an informal practice generating low revenues, that often encourages shifting from one plot to the other with adverse environmental consequences such as deforestation and soil degradation.
Indeed, the main and original idea is that the ashes from burnt vegetation are rich in minerals, and are therefore a source of natural fertilizer. However, without any additional fertilizer application (whether organic or not), the soil is quickly depleted, and farmers abandon the plots after a few years of cultivation to settle on other newly cleared plots.
This makes this technique an itinerant form of agriculture. The pressure on land availability and on the environment, as well as the progressive remoteness of agricultural plots from village centres, lead to an inevitable sedentarization of the 'abattis'.

However, these negative effects can easily be mitigated through soil conservation practices, as explained below. In addition, there is much opportunity in increasing farmers' revenues through soil fertility management, crop association, and the introduction of livestock with the added benefit of establishing the farmer and his family permanently in one plot. This can be a first step towards getting a property title and then be eligible for government help in acquiring small equipment to further increase yield and revenue. Improving the 'abattis' is much needed as it still plays an important role in local communities. It is a gradual process that requires a pragmatic approach. It is about striking the right balance between preserving tradition with its already existing good practices and gradually adopting more modern techniques.

Cultural practices

Soil conservation can be greatly improved in steep-sloped terrains by clearing the forest progressively with cleared strips along contour lines and preserved forestry in between. These preserved strips will act as a temporary buffer against erosion. The untouched strips can in turn be cleared once the risk of erosion has been reduced. Herbaceous covers such as *Desmodium ovalifalium*, *Arachis pintoi* or even edible peanut (*Arachis hypogaea*) can be planted in the very beginning of the rain season. It can be implanted to protect nude soils from rainfall impact and erosion. As they root down and spread quickly, they are able to retain the thin layer of topsoil within two to three months. Moreover, they enrich the soil with their nitrogen-fixing capability.

With selective clearing of the plot, cut logs and branches gathered together and placed along contour lines can act as obstacles against erosion and break water velocity. These stacks of logs lying across the plot along a contour line usually present too many obstacles for cultivation but can be wisely used to start planting a fast-growing hedge of trees that will later on act as a wind breaker and a permanent line of defence against soil erosion. The Inga tree (*Inga vera*) is a leguminous tree that offers spectacular growth and can form a thick hedge within two years. This tree has already widely been used in the reclaiming of highly degraded land throughout South America and can be used along with other fast-growing plants (*Cecropia adenopus* or "pioneer tree") or *Gliricidia sepium*, another leguminous tree.

Crop association is preferable to crop rotation as this practice allows saving "horizontal space" and makes better use of the vertical space by using different strata.
Numerous species are usually planted in 'abattis', providing a wide range of fruits, vegetables or subsistence crops such as cassava.

Some examples of relevant crop associations are: corn and green peas, with peas using corn as vertical support or banana trees used to provide shade to other trees planted in the inter-row, such as cocoa. In addition, hegdes can be used productively by associating for example pepper and *G. sepium*, the latter being used by the former as a vertical support. Wires can be strung between hedge trees to promote the growth of lianescent plants such as passion fruit (*Passiflora edulis*) and thus creating a new intermediate productive stratum. These wires can be also used for fencing livestock.

Working in 'abattis' can be tough due to the difficult access implying long walks while carrying goods, to the presence of remaining stumps and stones in the soil, etc.
However, it can be facilitated with the use of small machinery, such as the use of a small motorplough for creating planting beds. A portable thermal wood shredder also offers countless benefits. Wood chippings from the pruning of the hedges can be used as mulching applied on planting beds, protecting them from rainfall impact, erosion and also eliminating the need for frequent weeding. When wood chippings come from a leguminous plant such as *Gliricidia*, it can be used to produce nutrient-rich compost that can be incorporated in raised beds. There are current government incentives that cover as much as 90% of the investment cost in machinery and make this equipment extremely affordable, provided the farmer commits to specific environmental practices ("MAEC- Mesures Agro-Environnementales et Climatiques"). This however implies that the farmer has a title and access to government help, which is still seldom the case.

Livestock is rarely present in the 'abattis' for the simple reasons that it requires fencing, constant monitoring and a permanent source of water. However, if farmers make use of hedges within their 'abattis' as suggested above, livestock becomes a more attractive option that provides readily available manure, increased fertility, lower maintenance and an additional source of income.

Social aspects

The 'abattis guyanais' is central to agriculture in French Guiana. It involves families who are looking to maintain or renew with their former way of life while slowly adapting to the French Guianese socio-economic context. The 'abattis guyanais' is a way to offset the very high cost of living by providing free housing and cheap and palatable food for the family. This type of agriculture offers great potential for improvement and deserves greater public support, as it allows newcomers to gain a foothold in the French Guianese society. It has innumerable social benefits and lately some measures have been implemented to support this type of agriculture, such as the "Dotation Petite Agriculture" – a small money grant specifically aimed at subsistence farmers. As farmers begin to receive properly-aimed financial incentives to improve their practices, it will hopefully help accelerate agro-ecological improvements in the 'abattis guyanais'.

Deforested plot in French Guiana for the cultivation

of pineapple and citrus
© Julien Villard

Burning the forest after cutting it down, French Guiana
© Jean-Marc Thevenin

MAYOTTE: Jardin mahorais

General description

Agriculture in Mayotte is characterized by traditional production systems called "Jardins mahorais" representing more than 90% of the cultivated agricultural area. At the last agricultural census (2010), 15,700 farm households lived on a cultivated agricultural area of 9,000 ha.
Indeed, the total agricultural area represents 53,5 % of the 37 294 ha of Mayotte. 45% of this total agricultural area is actually used (cultivated arable land, grassland, orchards) and is evaluated at 9,000 ha.

'Jardins mahorais' are considered as agroforestry systems. They have several strata and combine several food and forest plant species on the same small area (usually less than one ha).
Three strata cohabit. The highest includes coconut trees, and other big fruit trees such as mango, jackfruit or breadfruit. The middle stratum includes medium-sized fruit trees such as papaya, citrus and guava, while the lower stratum can be used more intensively with subsistence crops such as cassava, banana, and various fruits and vegetables. Traditional cattle (mainly zebus) "vache au piquet" farming ("cow tied to a stake") is widely practised and can be associated with the highest stratum of agricultural systems.
These systems cover food needs, provide building materials and products for traditional ceremonies. They use very few inputs. Production is generally not sold except occasionally on an informal basis.

Cultural practices

The most represented crops are banana and cassava. Approximately 90% of the areas combine several food plant species, up to 11 or 12 per hectare.
Mechanisation and tillage are reduced. Weeds are buried, thus restoring organic matter to the soil. Natural fallows can be set up to let the soil "rest" and also feed animals.
The virtual absence of phytosanitary treatments allows 'Jardins mahorais' to find a balance between auxiliary insects and pests.

Social aspects

Farm management considers the social constraints of the Mahorais, which can sometimes seem more important than economic considerations alone.

Women represent more than half of the agricultural workers. Many farmers have another activity (civil servants, but not only), or are quite old or retired, but it is also common that the owner of a farm does not work on the farm himself and employs foreign workers.


Several aspects of Jardins Mahorais showing associations of crops, and "vache au piquet" ("Cow tied to a stake")
© Jean-Marc Thevenin and © Sylvain Gutjahr (last picture)


MADEIRA: Fazendas of Madeira

General description

Traditional Madeiran agrosystems (farms) are called *fazendas.* They generally have a size below one hectare and are run at a family level. They are organised in one or more small terrace or field plots (poios), bounded by volcanic stonewalls and irrigated by water canals (levadas), that bring water from the upper mountains. The structure of the Madeiran *fazendas* resembles the traditional terracing agrosystems found in the northern mountain valleys of mainland Portugal. Madeiran *fazendas* historically are the first agrosystems created by Europeans in outermost regions, and play a role in the settlement, creation and organisation of the territory and food security of its populations. In some places, *fazendas* resemble partially to tropical agrosystems, such as 'roça' (Brasil), 'milpa' (Central America) or 'chitemenê' (Africa) systems, because of the absence of structured terraces or field plots with stonewalls and levadas. The arable fields are aligned to terrain slope and contour lines and some elements of crop association (intercropping), agroforestry and livestock integration can be present.

Traditionally, the smaller *fazendas* can resemble home or vegetable gardens, where the plot area is intensively used, in horizontal and vertical strata and where fruit trees, banana, sugarcane, vegetable crops and/or aromatic plants are cultivated together. In the larger *fazendas* that have more than one field or terrace plot, the land can be organised in a mosaic of different crop cultures, with crops cultivated alone or intercropped.

The several terraces ensure a diversified food production that is used for the farmers' own consumption. The surplus is often exchanged with neighbours or sold in local markets.
Traditionally, fruit crops, especially vines and small fruits can be grown in soil cavities (Porto Santo), or protected by fences (sand, cast stones or plant barriers) or climbing on other trees or wood fences (Jardim da Serra Island and Porto Moniz).

Cultural practices

The climatic conditions of Madeira, its mountainous landscape and the different altitudes, allow for a wide range of crops to be cultivated, from Mediterranean crops, to fruit trees to (sub)tropical crops. For example, in the mountain *fazendas* of the south and north coast of Madeira, banana, sugar cane and sweet potato are planted at lower altitudes whereas taro, beans and different leguminous, cereals and vegetables are planted at higher altitudes. On the same way, subtropical fruits, such as avocado, custard apple, mango and papaya are partially replaced by temperate fruits such as apple, cherry, citrus, figs, pear, plum, chestnuts or dry fruits, and red berries when altitude is increasing.

The traditional agrosystem is an extensive farming system with a low level of mechanization and based on limited inputs, crop rotation, intercropping or pluricultural practices. The only *fazendas* monocultures are farms producing banana and grapes in the south and north coasts.

The soil is deep and of volcanic origin with high levels of organic matter. It is highly fertile and plays a significant role in carbon sequestration and in providing environmental services. Madeiran farmers traditionally promote the incorporation of organic matter for instance by using practices as green residues incorporation, mulching and manure application, and by using soil covers to maintain the soil fertility potential.
Historically, temperate fruit and vegetable production in Madeira has a high economic importance. The fruits are exported to the European mainland as fresh products or as canned or dried fruits, or preserved in sugar syrups. They are also used to supply the many passing ships.

Nowadays, also other crops like wheat, sugar, wine and more recently banana, sweet potato and subtropical fruits are exported in the same way. The traditional *fazendas* of Madeira provide a diversified food production that ensures both own consumption as the marketing of surplus in local markets and local food supply chains.

Social aspects

According to the last statistical records (2016), the number of men and women in Madeiran agriculture is balanced, with about 17,000 farmers of each gender. During the last 40 years, the number of fazendas dropped from 29,050 to 11,617 farms in 2016, with loss of agricultural land and soil, production potential and agrodiversity. This is mainly caused by the pressure of urbanisation and tourism. Local farmers have not enough skills and resources to compete with highly subsidized foreign agriculture and suffer the negative impacts of global competition imposed by long distance unsustainable supply chains. Nevertheless, the *fazendas* still play an important social role in the maintenance of rural communities, the territory and landscape. The fazendas are key services providers at different levels such as: i) provisioning services, producing fresh food products for local food supply and food security, preserving local agrodiversity and genetic resources; ii) ecological services, such as greening and ecological focus structures, capturing carbon as soil organic matter or biomass, providing food resources for wild fauna and keeping a high number of wild native species in the agrosystems; iii) cultural and recreational services, that include the preservation of the landscape, patrimony (terraces and levadas), recreational activities, aesthetic elements and ethnographic traditions, used to attract tourists and to promote agri-tourism.

Typical fazendas on the slope of the mountain, Madeira
© Miguel A. A. Pinheiro de Carvalho

AZORES: Pomares tradicionais

General Description

Traditional Azorean fruit Orchards are called "Pomares tradicionais" (Traditional Orchards). They are generally smaller than 1.000 square meters (called "alqueire"). Many orchards have citrus fruits. Some also have bananas. The most frequent orchards are the so-called mixed orchards. The mixed orchards have 4 or 5 fruit trees of each species, combined with other fruit species whose production per plot is distributed over the whole year, mixing subtropical species with temperate ones (anonas, guavas, araçás, loquats, apple trees, pear trees, fig trees, etc.).

In some orchards, horticultural crops like potatoes, onions, cabbages, watermelons are grown under the fruit trees. In some of the orchards indigenous varieties of banana are grown. They have a smaller size and smaller but sweeter fruits that are much appreciated and sold mainly locally.
In the case of citrus fruit, it is common to find fruit orchards of over 50 years old. Traditional orchards are important for the preservation of old genetic material (50 years or more, in the case of citrus fruits) and of fruit tree varieties that are seldom used by producers with larger orchards and more industrial exploitation that use imported planting material of the Canaries and Madeira (in the case of bananas). There is specific support for the preservation of traditional orchards.

Cultural Practices

Cultural practices are limited. They include for instance the application of manure of bovine origin or some fertilizer of chemical origin, the pruning of fruit trees cleaning over the several years of fruit tree development. Hens are often seen as a way to control weeds and to naturally fertilise the plots. In some cases, the cover is brushed mechanically in order to control the growth and proliferation of weeds. Crop enemies are usually controlled with the application of very aggressive chemical pesticides.

Social aspects

The traditional orchards have a low production. The produce is mainly for self-consumption by the producers and their families, thus diversifying the consumption of different types of fruit and vegetables throughout the year. In cases where the orchard has parcels with a single species, for example citrus or bananas, part of the production is sold in direct selling points or in the producers' association.

Traditional orchard of citrus trees, Azores
© David Joãn Horta Lopes

Fenced Banana garden, Azores
© David Joãn Horta Lopes

Beside these orchards, Azores also produces pineapple, both in conventional and organic production systems. Most pineapple production is for tourist consumption and for exportation. The pineapple has a PDO certification that gives an increased market value to the fruit produced under these conditions, as well as to those produced with organic origin. The value chain for organic pineapple is very short with direct selling from producers to tourists or consumers.

The 'pineapple of the Azores' Ananas comosus L. Merr., Smooth Cayenne variety, is a product of Protected Designation of Origin (PDO), produced exclusively on the island of São Miguel.
It was brought from Brazil by Portuguese navigators; the pineapple was introduced in São Miguel in the 17th - 18th centuries. Initially considered as a botanical curiosity, its production gained importance from the 19th century onwards, thanks mainly to the efforts of generations of farmers who persistently perfected the cultivation techniques that gave its specific characteristics. The production of Pineapple from the Azores is nowadays of particular importance for the regional agricultural yield.
It is grown in traditional greenhouses on the island of São Miguel, situated mainly on its hottest and sunniest southern coast. In all stages of cultivation "warm beds" are used, prepared from firewood (soil used in previous crops / cultivations), sawdust and wood shavings and "leiva" (a material that is prepared from spontaneous herbs and plants, together with the most superficial layer of soil. It is collected from high altitude non-cultivated land.) The planting density is 33,000 to 45,000 plants per hectare. Harvesting takes place two years after planting.
The cultural conditions of the Azores pineapple differ from all pineapples produced worldwide, due to the organic production and protected environment, in a subtropical climate, with colder temperatures and varying photoperiods throughout the year. These factors give the pineapple unique characteristics.




Traditional cultivation of pineapple under greenhouse conditions in Sao Miguel Island, Azores
© David Joãn Horta Lopes

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SWOT Analysis

	French Guiana	Mayotte	Madeira	Azores
Strengths	Abattis Guyanais rooted in traditional societies, producing types of food highly accepted by the community. Strong and robust systems not prone to diseases. Plant material readily accessible. Beneficial plant interactions in crop associations.	The system is adapted to the local context and can provide production throughout the year, in order to meet the food needs of families. The large soil cover helps limiting soil erosion. Itis considered as an agro-ecological balanced system.	High agrodiversity, crops adapted to local conditions, pluricultural and intercropping systems, agritourism attraction. The diversity of crops cultivated all year round favours the availability of diversified and qualitative food and ensures the farmers' income. The small size of the fazendas entail no need for heavy mechanization of agriculture. High soil quality and productivity. Overall, the agro-systems under use show low degradation.	Traditional fruit production system that ensures self-consumption by the producer and his entire family and contributes to a decrease in imports from abroad.
Weaknesses	Lack of access to infrastructure in utilities. Harshness of the manual chores. No mechanization. No long-term planning due to lack of property title, no incentive in investing time and effort in land that is not owned. Lack of farmers' organization and structuring of agricultural sectors.	These traditional systems face some issues such as: i) the population growth, ii) water and land availability, iii) limited investment, iv) limited access to inputs, v) lack of value chain structure. Losses due to theft and predation by wild animals such as lemurs and dogfish are high.	Aging of rural population, and abandonment of rural areas and fazendas, increase the negative trends with loss of soil and agricultural patrimony. Low technical skills of older farmers. Low interests of young people to embrace the agriculture and farmers activity The difficult access and difficult mechanisation makes the activity very labour intensive and increase the production costs. Small fazendas area does not allow high productions.	Poor productivity and caliber of the fruit produced that in terms of competition and production premiums cannot compete with commercial varieties and the production of orchards with higher and improved varieties
Opportunities	Agroforestry is a recent but constantly expanding body of knowledge with constant discoveries of new relevant crop associations. Emergence of niche markets (Vanilla, Cocoa, Rosewood, Aquilaria). Financial incentives for formals farmers.	Population growth seen as a weakness can also be considered as an opportunity. The diversity and availability of food crops associated with animal breeding could help to structure value chains. With improvement, the system can help covering 100 percent of food needs.	Organic farming and production of high-quality local food products. Production of subtropical fruits and vegetables. Recognition and added value of agrosystems provisioning, ecological, support and cultural services. Introduction of new management and planning technologies applied to traditional agrosystems. Development and use of new practices and use of farms waste as organic fertilisers or bioprotectors to assist the farmers to adapt to global changes, including climate change. Diversification of crops and food production around all the year takes advantage of the landscape. Agriculture as promotor of territory use and tourism attraction, Agritourism.	Sustainable, ecological production system with no environmental impact that can have its market niche, providing the producer with an added value in case of ecological production and with certificate of origin.
Threats	Rampant urbanization. Progressive abandonment by future generations. Loss of traditional practices Soil erosion.	Banana and cassava are grown as monoculture respectively in 21% and 27% of their production areas. Intensification of practices in traditional systems may not have an impact on these lands. Farmers with multiple activities may not see agriculture as a priority and thus may not make enough effort to adopt innovations and change their cultural practices.	Global competition, climate change, high production costs Low societal support to local farmers and the agricultural sector, with media and activist disbalancing advertising the negative impact and minimizing the importance of local agriculture. Water resources decrease, absence of water irrigation management politics, low level of precision technologies in irrigation and farms activities. High impact of urbanization, tourism and human pressure on agricultural land and reserves. Absence of positive discrimination politics to avoid the conversion of land areas for other uses.	Market demand and caliber of the production obtained that can lead to the abandonment of these regional varieties leading to an irrecoverable loss of the genetic heritage of traditional regional cultures

Table 1. SWOT analysis for several traditional systems found in outer-most regions in the EU

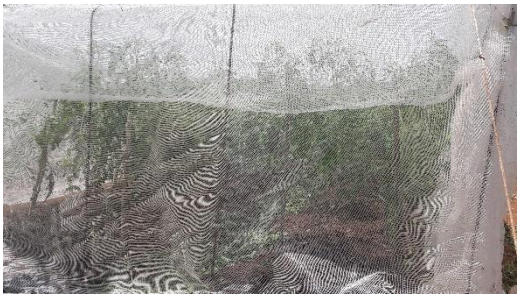
Innovations

In recent years several innovations were introduced in Madeira's agricultural and agrifood sectors, in an attempt to create conditions for the farmers to compete for the local market and as principal suppliers for the local population or tourism. Examples of these innovations are: the development of organic farming, agroforestry, agroecology concepts, the use of local climate-smart landraces, the use of smart irrigation and fertilisation systems, small mechanisation, hydroponic systems, greenhouses. The local agricultural fresh produce is sold directly to final consumers, through the local market and stores, or processed as food products of 2 to 4 range products. Examples are: the industrial processing of sweet potato by a local milling enterprise with production of flour to produce traditional batata bread, a Madeiran PDO. On the other hand, the processing of local fruits for production of traditional beverages and desserts.

In French overseas departments, several innovations have been developed or met during the past years, within the frame of RITA "Réseaux d'Innovation et de Transfert Agricole".

Some examples are described below [1].

Tomato, cucumber and eggplant fruits can be effectively protected against fly bites by installing nets over the crops during the hours of activity of these pests, Mayotte



© Cirad

BRF (Bois Raméal Fragmenté – Chipped wood) and straw or dried grass are widely used in organic farms in French Guiana to protect soil against weeds, erosion and drying while providing nutrients.

© Jean-Marc Thevenin

[1] https://coatis.rita-dom.fr/osiris/files/PlaquetteDePresentationDesRita2019_fichier_ressource_plaquette-rita-2019.pdf
For more information: https://coatis.rita-dom.fr

Associating High Value-Added plants like coffee, cocoa, vanilla to other crop plants like bananas is a way of optimizing the use of land and increasing farmers' incomes.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Associating tourism and agriculture is a way of increasing farmers' income. Plantation of ylang-ylang in Mayotte for the extraction of oil




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Conclusions

Agriculture in (sub)tropical European territories can take many forms, ranging from self-sufficient family farming, rather on small areas, to more intensive production in more or less organised sectors. The evolution of markets and consumer demands bring new needs to traditional farmers (food, education, health, access to new technologies, etc.), and income increase becomes necessary.
Several avenues are open to them, including combining farming with another economic activity and the intensification of their agricultural system, with increased productivity, improved product quality and access to market and distribution channels, etc., i.e. to place their activity in a more remunerative market circuit. In regions where family and social values are important, it is however not easy to reconcile changes in the farming system with the conservation of traditional values.

Traditional systems should receive specific attention, as they have a strong potential for agroecological transition. Even though some innovations have already been developed, there is always a need to improve them, to adapt them to new conditions, or to develop new ones when new constraints appear. Indeed, traditional systems are, like all agricultural systems, subject to climatic hazards (temperature, rainfall, frequency of extreme events, etc.). Faced with them, strategies for adapting to these changes are under way (use of adapted varieties and breeds, use of agricultural practices that respect soil life, crop association, use of local biodiversity, etc.) as well as mitigation strategies (consideration of circuits on a territorial scale, reduction of carbon impacts due to deforestation, certain forms of livestock farming, etc.) making it possible to protect water, soil and biodiversity resources.

A transversal SWOT analysis of several traditional systems found in the outermost regions (ORs) allowed us to highlight their advantages, limits and perspectives, to identify common challenges and opportunities, and so, to highlight the need to work collectively and transversally between in ORs to imagine ways to intensify agricultural production, which, while not disrupting other services (like social aspects), would improve farmers' incomes and preserve the agro-ecological character of these production systems.
Identified needs can be clustered around 2 main ideas: a better understanding of the functioning of the traditional systems; an intensification of the traditional systems while preserving agro-ecological and social dimensions.

Research needs and ideas for innovative projects and Operational Groups

Several common needs appeared for the production in outermost regions. These could be the base for building multi-states research projects or for launching Operational Groups across-regions, depending on the Technology Readiness Level (TRL) of the technology responding to the need.
However, we should not forget that the improvement of traditional systems is also conditioned by:

- a better access of farmers to land property, advice and incentive;
- a simplification of the implementation of research and development funding programs, in particular so that small companies with difficult cash flow can participate in research and development projects.

	Theme	Identified gaps / Justification	Ideas for research project
Better understanding of the functioning of the traditional systems	Characterization of traditional systems	We should consider that performance of these systems is not granted. It is therefore essential to first record, describe and characterize the traditional systems. It will then be possible to analyse and compare their performance.	*Develop and apply a multicriteria framework to evaluate the services provided by traditional tropical cropping systems in ORs:* . Build tools to calculate /estimate ecosystem services at the farm level . Evaluate and compare the performance of the different systems *Develop research to design eco-intensive traditional systems and adapt them to local conditions:* . Apply participative design methods . Consider multicriteria evaluation, including the services provided
Intensification of the traditional systems while preserving agro-ecological and social dimensions	Organic fertilisation	One way to intensify the performance of the systems is through the good management of soil fertility, using organic matter either from plants or animal dejections.	*Explore and evaluate the eco-efficiency of traditional practices in terms of fertilisation:* . Circular: Manure to worms to chicken food to chicken manure . Microbiome research . Better characterise the quality of organic fertilizers produced on the farm (mineralisation, choice of fertilisers, consider manure, composts, green manure and biostimulants, …) . Cover-plants whether already known for their nitrogen-fixing capacity, whether to be discovered within the local wild plants
	Integrated Pest Management	There is a need to better understand the functioning of empirical IPM methods used in traditional systems.	*Explore and evaluate the eco-efficiency of traditional practices in terms of fertilisation:*

		It will then be possible to analyse how to take advantage of this knowledge to improve, adapt, imagine new methods.	. Microbiome research . Characterize the biological diversity (plants, insects, etc) within the systems will help in this understanding and in improving the systems by better mobilizing this biodiversity
	Markets and transformation	Most territories have a deficit in their agricultural and agri-food balance. Small-scale processing of farm products and knowledge of markets can contribute to increasing the income of traditional systems.	Market characterisation Small-scale processing Societal expectations
	Innovation and adoption	Innovations sometimes have difficulty being adopted by a large number of farmers who should benefit from them.	Analysis of the obstacles to the adoption of innovations: structuring of sectors and organisation of producers, isolated farmers, access to financial aid and advice, adaptation of agricultural advice and technical support, the place of the farmer in co-conception, availability of technical and economic references, etc.
	Social acceptability of agronomical intensification of traditional systems	Traditional systems have been anchored for decades if not centuries in the territories. Bringing agronomical innovation in such context could be very disruptive and destabilising and finally not accepted by farmers. Even though participative methods are used to build research and development actions responding to farmers agricultural needs, social benefits and constraints are maybe not always or not enough taken into consideration.	How agronomical progress and change of practices can have an impact on social life and traditions.

Table 2. Ideas for research needs from practice

	Theme	Identified gaps / Justification	Ideas for operational groups and other innovative projects
Better understanding of the functioning of the traditional systems	Building new systems	Taking the best of each traditional system, combine and adapt them to build and test in several localities across regions. Depending on regions, systems should associate crops and livestock.	
Intensification of the traditional systems while preserving agro-ecological and social dimensions	High Value-Added crops and agroforestry systems	One way to increase farmers income is to combine HVA crops with traditional food crops. More broadly, eco-efficiency of traditional practices combining a large diversity of crops and trees in agroforestry systems should be evaluated.	Co-conception of multi-species cropping systems containing perennial species; technical and economic conditions for their viability Attention can focus on cocoa, coffee, vanilla plants in association with nitrogen-fixing trees.
	Ecoefficiency of traditional practices combining crops and livestock to limit inputs	A special attention should be paid on circular management of organic matter within the farm, including the use of livestock	Explore and evaluate existing practices regarding: use of green covers with leguminous crops or cereals to improve soil fertility and avoid soil erosion; use of animals for weed management; use of organic manure as fertilizer, enhancement of self-sufficiency in animal feeding, mechanisation, etc.

Table 3. Ideas for operational groups and other innovative projects