

DYNAVERSITY

Cross-border Network of Fruit Genetic Resources

(Belgium/France)

Case study analysis

DYNAmic seed networks for managing European diversity:
conserving diversity *in situ* in agriculture and in the food chain



DYNAVERSITY project received funding from the European Union's Horizon 2020 Research and Innovation program under Grant Agreement n. 773814

PART 1: DESCRIPTION

1.1 Contextualising the case

The following case study reports on a cross-border network of fruit genetic resources (Walloon Region in Belgium and North-East region of France). This study is interesting in the sense that it brings together two public institutions for the management of genetic resources and actors from different fields (i.e. nurserymen, producers, amateurs). This collaboration seems to provide robust elements that contribute to the development of the network.

The first steps of the network date back to 1975. The starting premise was to rescue "old" varieties of cultivated fruits that could be successfully grown without chemical phytosanitary products. The plant pathologist C. Populer of the Centre de Recherche Agronomique (CRA-W) in Gembloux (Belgium) thought that varieties created before the era of plant-health products had developed a natural tolerance to pathogens, and therefore registered resistance traits in their genetic heritage thereafter. In order to test his hypothesis, the researcher tried to find these varieties in Walloon breeding collections. Intrigued by this "plant census work", the Walloon Region granted him a subsidy to encourage a systematic survey of the fruit trees present on its territory. In a second step, the collection was enriched, thanks to the media coverage of this prospecting and people brought Populer fruits that had descriptions of the variety and the history of its conservation.

In order to meet the initial hypothesis, the varieties had to be evaluated and associated knowledge developed with each variety. Since 1975, old varieties and individuals of 1200 apples, 1000 pears, 350 plums, 200 cherries, 70 peaches and 80 grapes have been tested and stored in the CRA-W conservatory orchard. This collection is the starting point for a series of research works and projects.

On the basis of this work, a cross-border network for the preservation and enhancement of the territorial fruit heritage was developed and structured.

In the 1980s, in northern France (Hauts-de-France), R. Stievenard was in charge of developing the safeguarding of the territorial fruit heritage for the Regional Centre for Genetic Resources (CRRG). It takes as a model the method of gathering and maintaining a collection developed by C. Populer at CRA-W. Sharing this method of collection and evaluation contributes to the robustness of the resulting observations.

1.2 « Doing »

1.2.1 Properties WITHIN the initiative (closure)

As a research institute, CRA-W must be rigorous and objective with the material it works with. Thus, before being able to offer these genetic resources to interested stakeholders, the CRA-W must evaluate it thoroughly.

The evaluation of fruit trees requires the establishment, by each of the public institutions (CRA-W and CRRG), of an orchard on their respective premises. This allows each to carry out observation and evaluation work on the entire collection under similar pedoclimatic conditions. The characterization of each variety requires several years to obtain reliable and robust data on the characteristics of the varieties. Knowing the particularities of each variety makes it possible to determine their future potential in order to imagine "intelligent" crossbreeding (a term used by one of our interlocutors) and move towards a more autonomous and ecological orchard. The characterization of genetic resources develops and enriches the knowledge of the CRA-W and leads to the creation of variety sheets that include their different specific features. These variety sheets are the first steps in the work of enhancing the value of the preserved heritage, which may then allow for further multiplication and dissemination of the resources conserved.

The complementarity of the CRA-W and the CRRG, both on scientific and practical aspects, make it possible to set up a cross-border development network. These two actors are at the origin of the diffusion of these varieties in the network. They hold the physical resources by conserving them and making them available by multiplying them. All these varieties are vegetatively propagated by grafting. The CRA-W and the CRRG allow the valorisation of this plant material within the network, and beyond it thanks to the creation of new valorisation structures.

1.2.3 Transformative effects beyond the initiative

The conservation and characterization work carried out by the CRA-W and the CRRG has allowed the preservation of a very diverse and indigenous fruit heritage. During the years of collection and analysis of these varieties, the plant material remained in both public institutions.

In a second step, the two public institutions promoted and disseminated their work. The objective of these two actors was to (re)introduce these old varieties to producers and the general population and to show their value and use. CRA-W and CRRG decided to participate in the restructuring of the high-stem orchard sector through the organization of field actors.

The restructuring of a sector requires long-term work. The first step was to expand the conservation network. The second step was to identify and construct a multiplication and marketing channel. The third step, which is carried out in parallel with the first two, is the creation and distribution of new varieties. The last step, for now, has been to bring together supply and demand by bringing together all the players in the sector, thanks to the steps taken upstream.

The following sections describe this process, implemented with the help of independent entities, which participated in the launching of the old fruit varieties and the construction of the fruit network.

a) Extension of conservation: construction of a network of conservatory orchards

In addition to their own conservation and observation orchards, the two public institutions have each set up a network of conservatory orchards. This network has a double function: to strengthen conservation by duplicating the collection, and to disseminate the species studied, beyond the two research centres. The desire to duplicate the collection was motivated by two main reasons. First, conservation done in a single site seemed too risky and too vulnerable. Duplicating varieties in an orchard network seemed more effective to ensure the long-term conservation of varieties preserved. Second, there was a desire to disseminate the collection in different soil and climate conditions from those of the two institutes. Observation of varieties under different soil and climate conditions allows for further observation and characterization of plant material.

While the reasons for the development of a network of conservatory orchards has been similar for the two institutions, the implementation of their conservation differs slightly. This is detailed below.

CRA-W. The CRA-W network of conservatory orchards includes sixty orchards in the Walloon region. One of the main objectives was to return the varieties to their original territory. As a result, varieties are also redistributed to the people who have brought in seeds since 1975. Therefore, the orchards of this network do not host the entire CRA-W collection but only varieties native to each region are given. Between 2005 and 2008, orchards were set up by CRA-W, with the help of subsidies from the Walloon Region. The research institute provided its scientific and technical expertise to ensure the proper planting of the trees and their monitoring during the first five years. The establishment of this network involved both private actors and public administrations, such as regional nature parks or municipal administrations. Now it is the project leaders who ensures the sustainability of the network, with the help of a person responsible for the orchard who does a job to lead various activities in the orchard such as biodiversity awareness day, orchard maintenance jobs, and general product processing.

Voluntarily, the CRA-W moves away. The institute wanted local actors to be the project leaders. Through this process, local actors were able to reclaim their heritage through the (re)discovery of varieties and their uses, also rediscovering the landscape and ecological functions of the orchard ecosystem at the same time.

With regard to the various conservatory orchards set up, it would seem that the way in which the actors appropriate the project is decisive for the proper functioning and maintenance of the orchard. The appropriation of the project by the community and by the person designated responsible influences the sustainability of the orchard.

CRRG. The CRRG has set up a network of five local orchards with all the varieties conserved in this collection. These orchards are located in five Regional Natural Parks (RNP) and in partnership with local authorities. An agreement is signed between the three actors to guarantee the maintenance and sustainability of the site, as well as the implementation of a project to promote the fruits from these orchards. Farmers are also actors in this network. They participate in the maintenance of orchards and enhancement projects, most often oriented towards processing.

b) From multiplication to marketing: Certifruit

In 1985, CRA-W developed a way to distinguish between different kinds of old varieties. To do this, CRA-W developed the implementation of a variety 'range'. The objective of this range was to commercialise innovative and quality varieties following the observation work carried out by the institute. A variety is considered worthy of the mark of quality for its disease tolerance, organoleptic properties and diversity of uses.

CRA-W organizes this range into two categories. The first category brings together old fruit varieties from Belgium, Northern France, as well as part of Germany and the Netherlands, which are relatively common among the old varieties. This range is called traditional varieties (RGF-Trad). The second category only includes Walloon varieties, interesting for their taste and/or their use, but which are generally unknown to the public. Whether or not a variety is common depends on their frequency in marketing channels before the industrialization of arboriculture.

Today, these two ranges require identification to stand out in the market. Thus, CRA-W supports the creation of a traceability instrument called Certifruit. Certifruit guarantees the origin and quality of fruit genetic resources through a control system on nurseries that are members of a charter. The nurseryman is a key player in the propagation and diffusion of varieties. However, it may happen that the quality of their work is affected, in particular by an excessive multiplication of genetic resources. In order to ensure the monitoring and quality of the trees marketed, CRA-W has set up an identification system to maintain varietal identity throughout the propagation chain. This is based on a quality charter. The Certifruit system distinguishes between two categories of nurserymen: "artisan-grafter", who have signed the quality charter, and Certifruit-authorized retailers. Despite the distinction made between these two actors, their objective remains the same, which is to deliver guaranteed identity material.

The institute has identified a network of family nurseries with which it has signed a partnership agreement on the basis of the charter. The "artisan-grafter" receives the graft wood, free of all quarantine viruses, from the Centre d'Essai Horticoles de Wallonie (CEHW). The "artisan-grafter" is then the actor of the multiplication. She follows the young trees during the first years. The traceability of the trees is done via a labelling system. The graftwood and grafts are registered and labelled by their serial number. This label also bears the number of the "artisan-grafter", which makes it possible to trace the grafts back to the grafter in case of problems. When the work of this nurseryman is done and the trees are marketable, part of the final product is resold to Certifruit authorized resellers. Resellers are also under contract with CRA-W.

In addition, the varieties marketed are accompanied by their variety sheets, detailing their origin; the description of the fruits and tree; plant flowering period; and general susceptibility to diseases. Other sheets have also been produced by the CRA-W on pollination or tree-driving, for example. These are tools for nurseries to take advantage of the knowledge developed by the CRA-W and thus provide quality advice when marketing resources.

The Certifruit charter is now a recognised tool at an international level. French people come to buy from their partner nurseries as they have created a quality service. This tool is also in constant evolution and offers new varieties and tools every year. One of the ongoing projects is the development of the skills of field actors in tree planting and maintenance. Indeed, Certifruit wants to set up a training program to trace planters and pruners (two trades/skills poorly developed on the territory).

c) Creation, production, and marketing of new varieties: Novafruits

In order to enhance the value of interesting varieties resulting from varietal-creation work, the CRA-W and the CRRG have devised a structure that can position itself on a market, a 'niche', in order to compete the mass market. In 2014, the two institutions helped a producers' association to form. The objective of this association, called NovaFruits, is to promote more autonomous and ecological production orchards based on the principles of organic agriculture and by using rustics varieties. The association has voluntarily taken on a local dimension. It brings together producers from Wallonia, Hauts-de-France, and Normandy who will produce and test varieties proposed by the CRA-W and the CRRG.

For the CRA-W and the CRRG, the objective of varietal-creation is twofold:

- First, it helps to overcome the genetic bottleneck created by the modernization of arboriculture. For apples, half of the fruits sold worldwide come from five varieties. Thus, the CRA-W is developing an instrument for the commercial valuation of old varieties. CRA-W offers varieties that combine commercial interest (i.e. yields, sugar levels) with the potential for resilience due to genetic diversity.
- Secondly, varietal creation is necessary for the development of organic fruit trees. The 5 varieties that represent half of the production currently are also very susceptible to disease. Without phytosanitary treatments, they are not able to reach the end of the fruit. Therefore, there is a real need for producers to have access to disease-tolerant varieties, which can be grown without phytosanitary products.

The breeding process is supervised by CRA-W. It has the scientific expertise and structures necessary to set up reliable and effective protocols. Variety breeding programmes began in the 1980s within CRA-W, for the selection of scab-tolerant varieties. In the 2000s, the CRRG and CRA-W developed a joint pear breeding programme through an Interreg project called Biodimestica. This partnership also added value to the project through the sharing of observations between the two institutes. The cross-referencing of observations contributes to the robustness of their analysis.

In addition, CRA-W has trained some CRRG actors to carry out crossbreeding, such as J.B. Rey, the arborist in charge of the conservatory orchard. Each year, 4 to 6 crossbreeds are made. The choice of varieties to be crossed and tested is made in consultation with the two institutes during the winter season. The members responsible for varietal creation of the two institutes decide on the rootstock, one of which is an old variety that could potentially provide tolerance to diseases, essentially to scab.

Once the first fruits are developed, the seeds are harvested for testing. They are then sent to Gembloux, to the person in

charge of variety creation, T. Denis, to test their tolerance to scab. CRA-W has developed a scab strain inoculation protocol to evaluate the hardy character of new varieties. The seeds are first sown in greenhouses with CRA-W. After their first year, they are inoculated with various scab strains that were previously harvested in the institute's orchard.

It is important to note that both institutions are not looking for scab-resistant varieties, but tolerant-resistant ones. If the fruit is slightly affected by the disease, it can still pass this stage. Varieties that are too susceptible to the disease are excluded from this selection process. If the variety passes the hardiness stage, then other criteria are evaluated such as taste, size, and storage. The CRRG ends up putting potentially interesting varieties on rootstocks only if they have passed these different steps. The trees are grafted in the observation orchard and intended for professionals so that they can acknowledge these new varieties.

Both institutions have established a participatory process with member farmers. They are invited to test new varieties on their plots and share their observations, such as early fruit drop, in order to strengthen the observation work of CRA-W and CRRG. The producers' association participates in technical meetings to share these different analyses and highlight the most interesting varieties that deserve greater attention.

Both institutions have committed to obtaining a Plant Variety Certificate (PVC) for the so-called elite varieties, i.e. those that have passed the rusticity and taste stages. CRA-W and CRRG then become co-obtainers of the new varieties. This certificate system protects legally new varieties created by other actors, particularly for actors from the private sector. The use of these new products is exclusively reserved for member producers who have signed a contract with the association.

Currently three varieties of apples have obtained a PVC. Twelve are being tested by producers. The pear varieties are still in the testing phase, three of which have reached the end of the process. Currently, no new pear varieties are protected by a PVC.

Producers are active participants of the association in order to accelerate the varietal creation process and make it participatory. Therefore, they announce the varieties they wish to test at home and also give feedback on the varieties previously tested. The varieties protected by a PVC, as well as the ones under evaluation, are registered in the Novafruits catalogue, which contains the associated varietal characterization sheets.

One of the strengths of NovaFruits is also reflected in the diversity of the producers it brings together. Some producers work based on a family model with a 4ha farm while others work on much larger volumes of up to 40ha. All producers, however, sell their products in short circuits. This diversity of profiles also involves various uses of the fruit which require a variety selection based on other criterias, then also enriching the range of creative work of the CRA-W and the CRRG. Indeed, the first variety creation works were based on apples that can be eaten fresh, without any processing. From 2017, the selection process turned to industrial fruits for processing for the manufacture of compote, juice, and cider. One of the objectives of Novafruits is to move from a variety approach to a variety range. This would mean a more seasonal approach that would emphasize a different variety and use according to the seasons.

Another actor necessary for the functioning of Novafruits is the nurseryman. However, in the case of Novafruits, it is not at the heart of the system, it is voluntarily put in a secondary position. The nurseryman is a service provider, no longer the actor at the base of the production system. The CRA and the CRRG have set up a bilateral contract system with a nurseryman for each multiplication. The two institutions have deliberately excluded nursery growers in order to guarantee originality for the farmers and producers who are members of the association.

d) Extending the network, from producers to consumers: Diversifruit

The fourth element set up by the CRA-W to interest as many people as possible targets the structuring of the processing chain and its valorisation. The objective of this extension of the network is to structure the fruit sector in Wallonia. CRA-W found that a diversity of actors gravitated around the old fruit varieties, but that they were not coordinated. Active for several years in the field of valorisation of old fruit varieties, CRA-W has made its work known to many different types of actors including producers, arborists, amateurs, etc. It was the latter who wanted to promote the work done at CRA-W. In 2016, with the help of Marc Lateur of CRA-W, the Fédération des Parcs Naturels de Wallonie (FPNW) and some active actors in the field, drafted the statutes of the non-profit organisation, Diversifruit. In a second phase, the Diversifruit project completed the missions of the association. The association brings together enthusiasts of arboriculture Hight Stem (HS) who are active at the different stages of development of the sector. It brings together a panel of actors who represent, on a small scale, the profiles of Walloon HS arboriculture. The Board brings together the scientific aspect with the presence of Mr. Lateur du CRA-W; the technical aspect with the FPNW; and the practical aspect with the presence of professional arborist and conservatory orchard manager. Thanks to this mixture, the association develops around several goals, in particular those of coordinating initiatives in favour of the preservation of fruit diversity and informing, communicating and disseminating the knowledge associated with these varieties. To achieve this goal, the non-profit association is the actor who revitalizes the network of conservatory orchards and sets up days of activities that

contribute to the dissemination of the knowledge developed at CRA-W. These information and awareness days allow for the exchange of knowledge and experiences between actors.

In January 2018, the association submitted a project with the same name as the association (Diversifruit) to the Walloon Ministry of Economy concerning the development of a food system oriented toward the short circuit. This system is also developed by CRA-W and FPNW. CREDAL, an alternative financing cooperative, has joined forces with CRA-W and FPNW to support project leaders in a technical and economic way. Thanks to this heterogeneity of actors, the objectives of the Diversifruit project are multiple. The first concerns the preservation of the local fruit heritage of HS orchards. The second concerns the accessibility of HS fruits to consumers. The third objective wants to develop a value chain around HS orchards, mainly for professionals, but also for amateurs.

As with the other structures presented above, economic development is the gateway to heritage preservation. Thus, the objective of developing a value chain is the keystone of the project. This is what will make it possible to achieve the objectives of the project. This is done in several steps.

The first is the identification and federation of the actors who revolve around the production of old HS varieties. Thanks to the work initiated by CRA-W in 1975, the actors in the sector have already been well identified and structured.

The amateur channel is registered in a database, which is expanded upon with each request for variety identification at CRA-W or during the days of activities of the network of conservatory orchards organized by the non-profit organization Diversifruit. This list has grown steadily since 2016 and now includes about 900 names.

The network of professionals is also well identified, mainly due to the Certifruit quality charter, which brings nurserymen into direct contact with other professionals in the field. There are also "relay" people who allow supply and demand to meet. Processors are important actors to be federated for the establishment of a commercial sector. Many processors are also producers, who market their products directly for sale. In addition, there are some structures that only do transformation. Moving from the processing of base stem fruit (BS) to HS fruit is a real economic challenge for processing structures as HS fruit is almost twice as expensive as BS fruit.

Second, once federated, the Diversifruit project will propose to support professional actors by developing tools that allow knowledge to circulate within the network. Some tools are already in place and their effectiveness has been previously demonstrated while other tools are under development or consideration.

One tool that has proven to be effective is the creation of technical data sheets. Thanks to the CRA-W's scientific expertise and the observation work carried out since 1975, many sheets have been created. They popularize the knowledge of the research institute, both on biological and technical-practical aspects. Sheets have been created on the different tree diseases, technical itineraries of farms, tree management, pollinator groups, and collection, among others.

Another interesting tool for project leaders is the development of training. Training days have already been set up by the network of conservatory orchards, but professionals do not seem to be the target actors during these days. On the other hand, the Diversifruit project, and more specifically B. Cerisier, organised three meetings for the professional world so that they could benefit from specific support. These days are organised with other members of the Diversifruit network, in particular Credal and Diversifarm, to support them in their efforts and identify the needs and requirements of this emerging sector. Diversifarm's actors, for example, provide their expertise to support producers in their administrative procedures with regard to the AFSCA¹ health standards. These meetings/workshops bring together mainly professionals, but also draw-in other interested parties. These meetings have already led to the preparation of a new project aimed at developing a label and training. The different orientations that these projects can take are discussed in working groups during other days of meetings. For training, seven meetings were held with the working group. Together, they defined a subject that they found relevant by its content and the means necessary to implement it. Thus, a training course for planters and pruners was proposed in line with the Certifruit quality charter in order to redevelop lost know-how.

Thus, the various tools identified by the Diversifruit project would make it possible to federate and support, in a concrete way, the actors of the sector. The complementarity of missions of the non-profit association and the Diversifruit project make it possible to reach a wider audience and to bring together all the actors active in the HS domain. These two structures seem to provide an interesting dynamic for the future of the sector.

While the first objectives focused only on HS orchards because they convey the image of traditional landscapes to which some people still feel attached, an orientation towards sustainable orchards in general has been made. The project has

1 Federal Agency for the Safety of the Food Chain

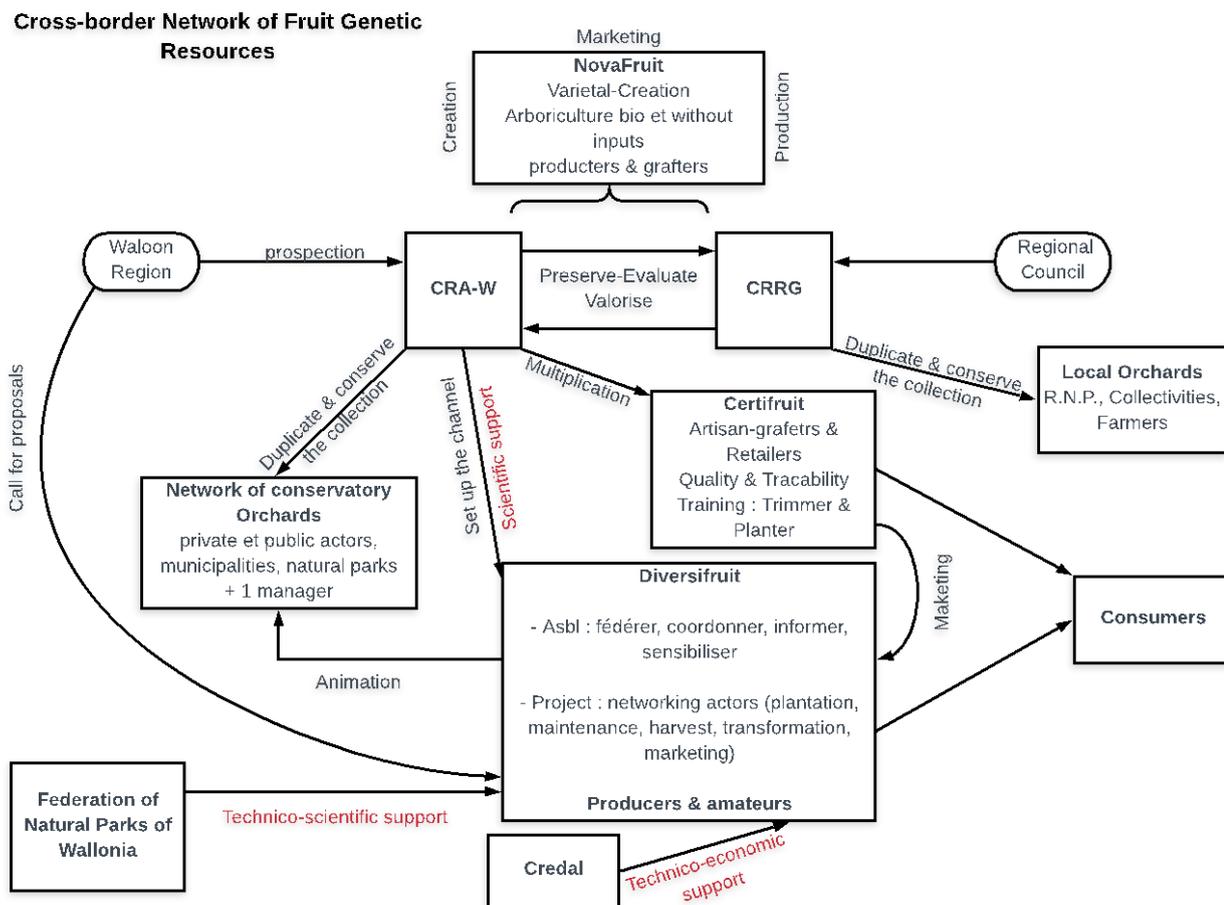
been extended to the orchard agroecosystem, one that tends to be the most sustainable and uses hardy varieties that require little or no input and that maximize biodiversity.

Thus, the Diversifruit network is a tool that allows the development of a local and profitable sector around the orchards without inputs from the networking of different actors within it.

1.3 « Organizing »

1.3.1 Properties WITHIN the initiative (closure)

The following figure schematically presents the different actors who compose and articulate the network, as well as the roles of each of them, which were presented in sections 1.2.2 and 1.2.3. The following diagram summarizes the structure of the network.



The network presented in this study shows role-sequencing along the supply chain. Each actor plays a different role. The two public institutions collect, evaluate, and disseminate. Some members of the network are specialised in multiplication, while others, such as the non-profit organisation Diversifruit, have broader general objectives like the desire to structure the sector by bringing together all the actors in the territory.

Structures developed within the cross-border fruit network all have a certain degree of autonomy. However, despite their independent nature, some structures are covered by the CRA-W and the CRRG. Indeed, these two actors hold genetic resources to work from. Together they decide on future crosses and, therefore, on the future direction of the network. Their criteria and experiences will determine what could be offered to stakeholders.

However, as a public service, CRA-W and the CRRG cannot satisfy the needs of the entire production chain. Instead, they

are led to join forces with certain external actors to develop a complete supply chain. In order to maintain a certain guideline, in terms of quality, for example, the two institutions establish contractual relations with certain actors. Certifruit nurseries, for example, are essential to the supply chain, but their work will be controlled by CRA-W. The artisan-grafter and multipliers of Certifruit are committed to respect a charter drawn up by CRA-W in order to have access to the plant material. The same applies to Novafruit association set up jointly by CRA-W and CRRG.

A certain ambiguity may be perceived here. The structures have their own governance system, some operate through a board of directors, while others are the property of a single person (e.g. nurserymen, private conservatory orchards). However, despite this independence, most of them are dependent on "their roots" (a term used by Mr. Lateur), i.e. old varieties owned by CRA-W and CRRG.

1.3.2 Properties BEYOND the initiative (outreach)

Most of the structures developed within the network have set up a business model in order to economically value their work. Identification systems have been designed to distinguish between products from the network and those from the mass market, thus generating added value for the network products. From trees to varieties and their processed products, all have a particular identification mark that differentiates them from a more classic model of arboriculture. Beyond the commercial demarcation, the trees and the fruits that are produced from them include all the work carried out upstream (i.e. collection, selection, creation, planting, harvesting, processing). Identification symbols are witnesses of this long process, which convey the idea of a new arboriculture that is more agroecological.

1.3.3 Transformative effects beyond the initiative

The reinforcement of the actors' knowledge can be presented under two points.

First, the work done by CRA-W by disseminating this knowledge, contributes to the empowerment of its members. Thanks to the different sheets created, members of the network have very rich knowledge. The transmission of knowledge contributes to the empowerment of each member. This sharing knowledge also makes possible to move towards a certain autonomy for the members of the network. CRA-W participates in the development of this autonomy by developing the background of the network's actors, and also the backgrounds of those beyond the network. All the sheets are made available to the public and can be used by everyone. Moreover, CRA-W does not see any competition in the extension of the network. On the contrary, they are proactive in efforts to extend the network. During exchanges with a Flemish fruit network, the CRA-W was very transparent about the actions they developed in Wallonia and France.

Secondly, the Diversifruit project also contributes to strengthening actor knowledge. Collective training sessions, set up by this structure, occur through discussion forums that allow the exchange of knowledge and experience between the actors to occur. Actors enrich each other when possible, generally for areas they master, such as processing. For subjects where the actors have less knowledge over the procedures, the Diversifruit project has joined forces with actors who have control over them. Diversifirme and the Crédal, for example, provide technical and economic support to actors. Some training sessions are designed to meet the needs and questions of actors. To help actors, Crédal structures their ideas in order to develop viable economic models through the creation of a business plan. Diversifirme sets up a workshop on the health standards that producers must respect in order to be in accordance with the legal framework.

PART 2: ANALYSIS

2.1 Knowing + 2.2 Framing

2.1.1 Properties WITHIN the initiative (closure)

At the origin of the initiative is the CRA-W, which, through its scientific research mission, creates knowledge. This knowledge comes from scientific practice; observation, characterization, followed by a process of evaluation of the genetic resources. Conservation through use helps to strengthen the production of knowledge. After a long period of rigorous and methodical analysis, knowledge becomes scientific knowledge and can be used by the network's stakeholders.

Within the network, sheets produced by CRA popularize the various knowledge products. They are accessible to all and are the subject of many specific field aspects of arboriculture: variety description, diseases susceptibility, tree management, etc. These are operable tools for the actor's network (mainly for multipliers, producers, and re-sellers).

CRA-W transmits the knowledge they develop and allow producers to appropriate it. They can also serve to arouse the curiosity of producers who would like to know more about old varieties and their uses.

Variety sheets, specifically, are educational tools to support and assist decision-making processes. Thanks to the scientific rigour of the CRA-W, the characterization of the varieties makes it possible to identify which varieties have been best adapted according to the desired use and the geographical area in which each is located. Thus, the various sheets are vectors of information that make it possible to overcome the "gaps" in knowledge of certain actors.

Another type of knowledge, derived from the practical experience of producers, is also present in the network. During sessions organized by Diversifruit, producers can share their knowledge, practical and theoretical experiences, and enrich each other through these exchanges. Training days include discussion forums that stimulate the Walloon network through the sharing of knowledge. Thanks to these exchanges, a group cohesion has developed that contributes to the creation of a shared identity; an identity of producers of old HS varieties.

2.1.2 Properties BEYOND the initiative (outreach)

Knowledge produced is also recognised beyond the network by various actors.

The research work carried out by CRA-W is more widely disseminated thanks to the scientific publications produced by C. Populer, followed by M. Lateur. Since the 1980s, several scientific articles have been written and published in scientific reviews. A set of themes has been addressed in these articles, from the interest in old varieties, to their resistance characteristics, to their organoleptic characteristics. Through the publication of the results obtained, CRA-W gives visibility to the use of old varieties and highlights the interests that can result from them. Then, the scientific sphere can take hold and put ideas into discussion. At the European level, C. Populaire was a pioneer in prospecting and conservation; other actors have taken the example of the practical model put in place at CRA-W to protect and conserve their own genetic resources.

In addition, one of the network's assets is found in the diversity of the structures that make it up. Structures share some objectives, but also have some of their own. A majority use economic channels to enhance the value of their work, though the channels used may be different. The marketing of trees and fruits carries with it a number of knowledge and know-how points, particularly thanks to the identification system. These identification systems have been thought out and developed by stakeholders in order to stand out from the mass market. Indeed, the supply chain developed by the network can be considered to produce products for a niche market. For the network, product differentiation is necessary to survive and compete with the mass market. The members of the Certifruit charter identify themselves and gather around the exclusive marketing of an innovative range. This information is conveyed beyond the network through the labelling system that guarantees the identity, traceability, and quality of fruit genetic resources, from CRA-W to the final consumer.

Another kind of demarcation is currently under discussion. That discussion is over the creation of a label that would make possible to distinguish products on the market by specifying their alternative production method and their qualitative added value. The creation of a label offers these two guarantees and passes them on to consumers and beyond. Thus, the products from HS orchards, guaranteed by a label, convey the associated knowledge in terms of nutritional quality, preservation of the environment, etc.

In addition, the knowledge gained from scientific practice, practical, and organizational experience can be recognised by other actors, who, in turn, can spread the model developed as well. The NovaFruits structure, developed by CRA-W, CRRG, and producers, has inspired new actors beyond the network. Its original system of protection and use, of the new varieties created, has attracted the Aquitaine regional plant conservatory, which is considering setting up a similar structure of their own.

2.1.3 Transformative effects beyond the initiative

This fruit network was born in response to an increasingly input-dependent arboriculture. The network strives for a new arboricultural paradigm which allows for the development of a more eco-friendly fruit production. In order to achieve this goal, several steps have been necessary.

The first has been the development of scientific knowledge associated with old fruit varieties. The role of the CRA-W was central in this step, in order to give a robust and recognized character to the data produced, even beyond the network.

The second entailed that varieties recognized as interesting and those resulting from varietal development programmes were to be the initial basis for research and development. The CRA-W disseminated these genetic resources through different channels. In order for stakeholders to take ownership of the interest of old varieties and actively participate in the implementation of a new arboriculture, the CRA-W has since popularized a large part of this scientific knowledge in the form of fact sheets, in order to share robust knowledge with stakeholders.

Equipping and accompanying the actors of the network in their own learning process has enabled the development of an alternative fruit sector, one where the actors can overcome the locking-out effect of traditional arboriculture (e.g. through dependence on inputs, mass market = low selling price = poor autonomy).

2.3 Networking

CRA-W and CRRG, the organizations that initiated conservation strategies, have played crucial roles in the establishment of this cross-border network. C. Populer, at the CRA-W genetic resources conservation initiative collaborated with R. Stiévnard of the CRRG, particularly in sharing methods for prospecting and collecting old varieties in untreated orchards. Subsequently, these human ties were maintained through the agreement between M. Lateur and J.L. Lebrun. Several factors may explain their collaboration which is also still present today between the two institutes they created. Sharing a similar vision and objectives in terms of conservation have been the two key elements to unite the two institutions. The two public institutions have implemented similar research methods and protocols to cross-reference their observations and make their work more robust. The varietal breeding process, for example, is a technique that has brought the two institutions together, beyond European programmes.

It is important to specify that the CRA-W is the scientific reference of the network and hosts M. Lateur, a key actor who allowed its structuring. Thanks to his expertise and public service status, the network has been able to expand by encouraging stakeholders in the sector to take up the challenges surrounding orchards of old varieties. Much of the knowledge held at CRA-W, produced by Mr. Lateur and his collaborators, is disseminated in the form of technical sheets for field actors. These are key tools for transmitting knowledge and enabling field actors to connect to the network. Today, thanks to his position and notoriety, Mr. Lateur is the bridgehead of the network. Mr. Lateur's research status also allows the knowledge developed at CRA-W *in situ*, to extend beyond the network's borders. The researcher and his predecessor, C. Populer, have published numerous scientific articles, particularly on the valorisation of ancient varieties of fruit and their organoleptic properties, allows this other form of knowledge to be made public and to circulate beyond the network as well.

However, as a research institute, some projects do not fall within CRA-W's remit. Nor do they fall within the missions of a research centre. Thus, Mr. Lateur has had to form alliances with key actors in the sector in order to develop the network on other activities and at different scales.

Nurseries also have a central role in the multiplication and dissemination of genetic resources. They are the bridge between the CRA-W and actors from private or public sectors. The same is true for the CRRG, which is a link between the CRA-W's knowledge and the nurserymen.

In general, the different structures (Conservatory Orchard Network, Certifruit, Novafruit, Diversifruit) set up around the CRA-W and/or the CRRG can be perceived as bridges. They are the links that allow trees and their fruits to circulate throughout the chain. Thus, this material and the associated knowledge link the different actors– scientists, technicians, arborists, and amateurs. Thanks to them, the sector is beginning to structure itself and collective and cooperative dynamics are beginning to emerge. Actors who were previously isolated, both geographically and organisationally, are now working together to enhance the value of the old fruit variety sector.

PART 3: SUMMARY

The first lesson learned from this case study comes from the layout of the network. Collaboration between public institutions and field actors has strengthened the knowledge and know-how from this network. Scientific, technical, and practical aspects are mixed within the network. This flow of knowledge and competence, shared between actors, seems to build the network and gradually brings it closer to its objective.

The second lesson that emerged from this case study concerns the importance of the exchange days between the network's actors. These days make it possible to take into account the needs and necessities of the actors, while also uniting them through the sharing of experience. The network is young and is beginning to consolidate, thanks to the construction of a strong core group of members.

Another central learning process resulting from the construction of this network concerns the transmission of knowledge and the involvement of stakeholders. It can be perceived within structures, but also between them. At CRA-W,

C. Populer's aspiration for an input-free arboriculture was passed on to Mr. Lateur, who in turn took over and maintained it.

Finally, a final lesson concerns one of the network's particularities. Upstream, it is supported by two public institutions. This particular character leads to public funding for the various research projects. Dependency on public funding weakens both structures because they have no assurance that budget envelopes will be renewed. At CRA-W, investment in breeding programs is relatively low, which limits faster progress. The CRRG is 95% funded by the Regional Council, but no one can ensure that this will remain the same if the Regional Council takes a new political direction. Currently, the operating costs amount to 250,000 euros. The CRA-W and the CRRG regularly work through European and/or regional calls for projects that allow them to obtain funding for a few years. Once again, these funds are sporadic and do not guarantee the sustainability of research and commercialisation projects.

In view of these elements of fragility, the CRA-W and the CRRG have developed tools and structures to allow them to move toward autonomy of the sector. They have created tools and devices capable of transmitting their knowledge and which can be activated through the various structures set up. The majority of the network's structures are tasked with developing their marketing channel, a resource that will enable economic enhancement to their work. Thus, these structures, which are being consolidated, will make it possible to maintain an innovative and promising sector, even if the CRA-W or the CRRG gradually withdraw.