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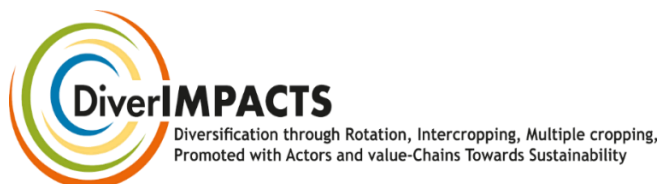
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Small-scale dehulling of buckwheat

Report of farm visits in Western France (March 2019)

Report and all pictures: Kevin Morel (UCL)

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Context:

The overall goal of **DiverIMPACTS - Diversification through Rotation, Intercropping, Multiple Cropping, Promoted with Actors and value-Chains towards Sustainability** - is to achieve the full potential of diversification of cropping systems for improved productivity, delivery of ecosystem services and resource-efficient and sustainable value chains. DiverIMPACTS has 34 partners in 11 countries (<https://www.diverimpacts.net>).

In one case study of DiverIMPACTS in the United Kingdom (case 15: <https://www.diverimpacts.net/case-studies/case-study-15-uk.html>), farmers and a small-scale processor were facing **difficulties in dehulling buckwheat**. Dehulling allows a wider range of products to be processed from buckwheat (dehulled grains can also be eaten as such) at a higher price than flour but is quite challenging to carry out at small-scale, with low efficiency.

The Université Catholique de Louvain, partner of DiverIMPACTS, organised a farm visit with British partners on 2 farms in Western France where farmers have developed experience and adapted processes to dehull buckwheat at small-scale.

The 2 visited farms were located in the Vendée and Loire Atlantique area in Western France. We thank those 2 farmers, who preferred to stay anonymous and will be called “Farmer A” and Farmer B” for sharing their knowledge and approving the final content of this report before dissemination.

Summarised information from the farm A

Farm A is an organic dairy farm which developed a complementary activity of on-farm grain processing.

Cropping and post-harvest practices

On his farm, Farmer A (the farmer) often sows millet and buckwheat together. The two crops are separated with the local cooperative's optical screener.

Yields for buckwheat: 1.2 T/ha

Yields for millet: 1.5-2 T/ha

Yields for millet-buckwheat intercrop: 1.5-1.8 T/ha

In case of intercropping, they sow 60 kg of buckwheat and 40kg of millet per ha (even if there is less weight of millet there are more seeds). For single cropping, they sow nearly the same density of buckwheat: 60-80kg. They sow the same density in intercropping because they use farm seeds (not expensive) and they are sure that seeds will develop. They choose to practice intercropping to simplify cropping practices (they sow both and harvest at the same day the 2 crops and the combination of the 2 crops limit weed pressure). The disadvantage is that the yield of buckwheat is not as high as it could be because when the intercrop is harvested based on earlier millet maturity.

UK farmers commented that on single cropping of buckwheat for flour, they were able to reach 2.2 T/ha because flour varieties have higher production potential. In Eastern Europe, they get 1T/ha, depending of course on soil and climate conditions.

In Eastern Europe, they harvest buckwheat after the frost because it stops the continuous flowering process. In the Vendée area, frost is coming too late to wait for it. Some farmers cut their buckwheat one week before harvesting. Farmer A tried it and made swaths before harvesting. However, he does not do it anymore and lets now buckwheat dry directly on the ground because swaths did not provide an optimal drying of the plant. To be sold, buckwheat needs to have a humidity content of 14.5%. However, for decortication, Farmer A thinks that 12% is better, so the drying will be more intense before decortication than for other uses.

Varieties

In France, buckwheat varieties most commonly found (95% of production) are *Harpe* and *Petit Gris*, which both are adapted to make flour. For dehulling, other “dehulling-friendly” varieties have to be used like *Billy*, which is quite difficult to find in France. On this farm, they use their own farm seeds which comes from the *Spacinska* variety.

Post-harvest management and on-farm processing

The drying is operated by the local machinery cooperative (with gas and temperatures above 40°C). Dehulling, bagging (mainly in 25 kg bags and sometimes in 1 or 2 kg bags) and milling are made on the farm. Farmer A told us that in China, a machine exists which combines dehuller, screener and automatic return of un-dehulled seeds to the dehuller. Farmer A thought about buying this machine but he was afraid to buy a machine so far away and not sure of the quality. So he developed his own on-farm system combining different machines.

They own a *Heger* dehulling machine (from the *Moulins d'Alma* company) which is used both for buckwheat, millet and sunflower. The dehulling machine works as a centrifuge. The projection of seeds on the centrifuge wall break them. There exists a dehulling machine specific for spelt but it destroys buckwheat. The dehuller they have is relevant for many crops. The output of the centrifuge is a mix of hulls, un-dehulled seeds, dehulled seeds and broken seeds. Hulls are taken out through ventilation and the mix is screened on farm. Un-dehulled seeds are sent back to the centrifuge and processed again and again (4-5 times).

For buckwheat, broken seeds are used to make flour. For millet, broken seeds are used as a specific product to make a millet porridge eaten as a dessert, which is typical in the area ("Millet vendéen"). Millet used to be very common in the area before rice.

At the end of the process, some un-dehulled seeds remain with the dehulled seeds (the ones which are the same size). The final mix needs to be optically screened at the local machinery cooperative. This transportation to the cooperative is not so expansive because of small volumes. Costs are higher for drying (also made at the cooperative) because volumes are higher and costs per T of product.

Out of 1 kg of buckwheat, the process produces 300g of marketable dehulled seeds and 400g of marketable flour made with broken seeds and seeds that were not dehulled. The dehulling machine can process around 1T per hour. After the first dehulling, 500kg need to be dehulled again. In total, he would realise 4-5 steps of dehulling. A better dehulling yield of 30-35% can be reached but it requires a higher number of dehulling steps, which implicates more time (main limiting factor) and raises costs. When they make only flour with buckwheat, the yield is about 60-65%. A critical success factor in dehulling buckwheat is finding the right speed of the machine. For buckwheat, it should not be too high (but he was not able to tell us the right speed because the machine had a just a speed scale from 1 to 100 and do not indicate absolute speed values). Maybe it is also part of his know-how that he wants to keep. To move buckwheat seeds, screw systems should not be used because they destroyed seeds. That is why they use an elevator.

They store the harvest (once dried at the cooperative) on the farm. They have no issue in storing buckwheat but have sometimes problems with moths for millet and spelt. The seeds are processed within one year after harvest. For flour, they mill the seeds when the demand comes. For dehulled grains, they dehull twice or 3 times a year. They put small flour bags in the freezer before selling and recommend to keep flour in the fridge once open. The shelf life for dehulled seeds is 1 year and 6 months for flour.

They have heard of a storage system allowing to keep seeds in big bags without oxygen. Each time you need, you can extract seeds and recreate an oxygen free environment afterward with a system of aspiration. Farmer A said that he was thinking of this option which would economically acceptable (investment) at his small scale.

For milling, he uses a machine from "Moulins d'Alma" and he is not happy with it. With their equipment, they could process much more quantities (at least 4 times more) but it would require to invest in storage facilities.

The flour they get out of broken dehulled seeds is quite white. So to match customers' requirements, they integrate a small share of hulls in the flour. As in every milling process, one

should be careful about the raise in temperatures. However, buckwheat seems less sensitive to this issue than cereals (sandy texture).

A discussion was led on the potential use of hulls, e.g. to make pillows. They tried it on 20-25 pillows because Farmer A's grand-mother had the skills for it but the hulls are mainly used for the animals (bedding). In South America they brew gluten free buckwheat beer as in Brittany.

Investment

To buy the dehulling machine, the miller, the mechanical screener and the elevator to move the seeds, they invested 40 000 €. They were supported at 40% by CAP subsidies for on-farm processing. They got a second hand "spelt brush" that they use to clean the dust after harvest.

Selling prices

They sell dehulled buckwheat in 25 kg bags to organic supermarkets and also in 1 or 2 kg bags. Prices when sold to the organic shop (Biocoop): 4.5€/kg for dehulled buckwheat and 2.5 €/kg for flour. Prices sold to consumers at the organic shop: respectively 5.8€ and 3.5€.

Market

In organic shops (like Biocoops, <https://www.biocoop.fr/>), most buckwheat comes from Eastern Europe and millet from the USA. At the moment, Farmer A grows only 6-8 ha of buckwheat and sells mainly to organic shops in 25 kg bags. He does not want to deal directly with consumers (as a livestock farmer, he is already quite busy). He is the only one to dehull buckwheat in Vendée and the farm is quite famous for it now (more than 15 newspapers have been written about their experience). The demand for local buckwheat is much higher than the current production. In the organic Biocoop shops, they sell both East-European buckwheat and Farmer A's local buckwheat. When Farmer A's products are on the shelf, consumers buy them quite quickly. Local buckwheat seems to have a far better flavour.

Eastern buckwheat is 35% cheaper than Farmer A's one but the organic shops buy it anyway because the demand for local products is strong. Step by step, the shop raised the prices of Eastern products to make them similar to Farmer A's. In a way, it is fairer for Farmer A but the shop is making much more money on the Eastern products (so not so fair to consumers). At the moment, Farmer A's selling prices are ok to cover production costs and make a little profit but they should not be lower. He calculated that he is making the same profit with those products as with selling milk. Farmer A said that if he had a more business oriented mentality, he would have the means to find other channels to sell at a higher price. He is not interested so much in this option.

According to him, dehulled buckwheat is still a niche in the organic niche. However, he thinks that the growth of the organic, gluten-free demands also make people think about new food plants and that this will benefit to buckwheat. Conversely to the UK, Canada or the USA, low-carbohydrate diet does not seem to be a major concern in France.

Cooking of dehulled buckwheat

Boil 1.5 L of water. Add 1kg of buckwheat and leave it covered during 20 min at low fire. Do not stir if you do not want to get jam!



The Heger (Moulins d'Alma) dehulling centrifuge



The elevator (in the middle), the mechanical screener (top left) and the mill (top right)



Dehulled buckwheat before bagging



A 1kg bag of organic dehulled buckwheat

Summarised information from farm B

Global context and overview of farming practices

The farm is a family farm, certified organic since 21 years. The Loire Atlantique area where the farm is located is the second *département* in France with the highest share of organic acreages, due to the urban demand of Nantes.

Farmer B's parents started to diversify their production with sheep. The sheep crisis struck Farmer B's parents badly and they had still many loans to pay, so they decided to diversify with other activities (e.g. chickens) and to create more added value on the farm with short supply chains. They still raise 6000 chickens a year, which are killed on-farm for meat. All farm productions are sold in a short supply chain logic. They produce hemp, rapeseed, sunflower oils and dehulled seeds of buckwheat and sunflower. They are also starting to make bread. The farm is 80 ha and provides work for 6 people (5 associates and 1 employee). Most post-harvest operations are made on-farm: drying, cleaning and processing. Buckwheat is grown on 10 ha.

Tillage is not systematic and often superficial (10 cm deep). The rotation involves a succession of winter and spring crops. For wheat and cereals, they use landraces. Grain mixes are harvested to feed the chickens. Fertility renewal is ensured by chicken manure, green manures and legume crops (no commercial fertilisers bought).

They harvest hemp with a combine but it takes time and requires to be gentle and wait if the tractor gets too hot with the fiber that is chopped on the field (for 4-5 ha it is ok). A good yield would be 0.8 T/ha. Most of the time, they get 0.5-0.6 T. To use hemp fibre for building they would need to use a specific machine from the cooperative to extract the outer fibre of the plant.

Farming practices and varieties for buckwheat

The buckwheat varieties adapted to make dehulled grains have lower yields than the ones for flour. For dehulling, *Kora* and *Spacinska* can be used. In general, varieties adapted to dehulling are do not make good flour. On the farm, they use *Spacinska* based farm seeds for dehulling. They grow also *Petit Gris* to mill only as flour or to mix with *Spacinska* to get tastier flours. Last year, they tried to sow together a mix of *Spacinska* and *Petit Gris*. This allowed good adaptation to different soil and climatic contexts. They reach yields from 1 to 2 T/ha.

The sowing date depends of course of the climate but it is really better to sow as early as possible (April) and to harvest in late September or October of late varieties (seeds for flour are harvested earlier).

Post-harvest management of buckwheat

For cleaning, they use a rotary *Marot* cleaner, that they are very happy with. They also clean crops of neighbours. 100 T of seeds are dried on-farm each year, especially spring crops (buckwheat, corn and sunflower). They have self-built a flat dryer working with a fan producing air and with a heater which blows on it. They have two distinct buildings for post-harvest operations: one for operations producing dust and one for other operations (processing).

For processing buckwheat, they clean and dry it before dehulling. For dehulling buckwheat, 14% of humidity content is fine. They tried with lower rates (7-8%) and it was too low. Seeds were too dry and broke. As on Farmer A's farm, the dehulling of buckwheat is an iterative

process combining (1) a gravity table to calibrate seeds (the smallest seeds with low dehulling yields are directly milled into flour), (2) the dehulling with the *Heger* centrifuge, (3) first step of mechanical screening of dehulled seeds, broken seeds, hulls and undeulled seeds with air (old *Tarare* machine for winnowing), (4) second step of mechanical screening with a moving grid (5) automatized sending back of undeulled seeds to step (2). At the end of the process, they use an optical screener, 3 times to get a very good result (see picture at the end synthesising the process). The optical screener and the gravity table are owned by the local cooperative but located on the farm.

Farmer B developed a real know-how to parameter all the different steps and connect them. For example, finding the right speed of the winnowing machine is critical.

To move seeds between step (3) and (4), they use an inclined screw. On the first farm, Farmer A suggested not to do. Farmer B said that if you are careful and slow, it is ok even if an elevator is probably better. The use of the gravity table allows to reduce costs because it makes possible to keep only the bigger seeds that have a higher dehulling yield. At the end, it also decreases the cost of using the optical screener. The optical screener is based on cameras and ejectors using compressed air. Optical screening operates at a speed of 300-400 kg / h (it is the slowest step of the process). Thanks to his system, he can get a yield of 33% for dehulling buckwheat with only 3 uses of optical screener at the end. More iterations would result in more broken grains. With broken dehulled grains, the resulting flour is very white, which is fine if it has to be used in processed food as a gluten free alternative. For people looking after buckwheat flour as such, they incorporate some hulls to give to it a darker flour (as Farmer A).

Parenthesis on pressing oil

They have got an oil press on the farm. Out of the pressing, they get cakes and oil that they filter and leave decant for 3 weeks. They produce 8000 L of rapeseed oil per year, which is easily sold in local organic shops. The only oils that are 50ct-1€ cheaper/L come from Italy but people are happy to pay a bit more if the oil bottle has a nice picture and stamp proving that it is local.

Investment

They bought the second hand rotary *Marot* cleaner 7 000 €. To buy the dehulling machine, they invested 8000 € (same dehuller as Farmer A's, *Heger* model of *Moulins d'Alma*). They paid the optical screener 80 000 €, 5 years ago (including air compressors that go with it; they invested in compressors with anti-bacterial filters because they are processing human food). For setting up the whole device, 10 000€ more were spent. The local cooperative made that investment and Farmer B is hired as a subcontractor (he has got the know-how) by other cooperative members to optically screen their products.

They also act as subcontractors for dehulling (the price is 200€/T of output products). They have created an independent society separated from the farm for such subcontracting activities. They just make bagging for the farm products (time consuming). For the neighbours they deliver big bags.

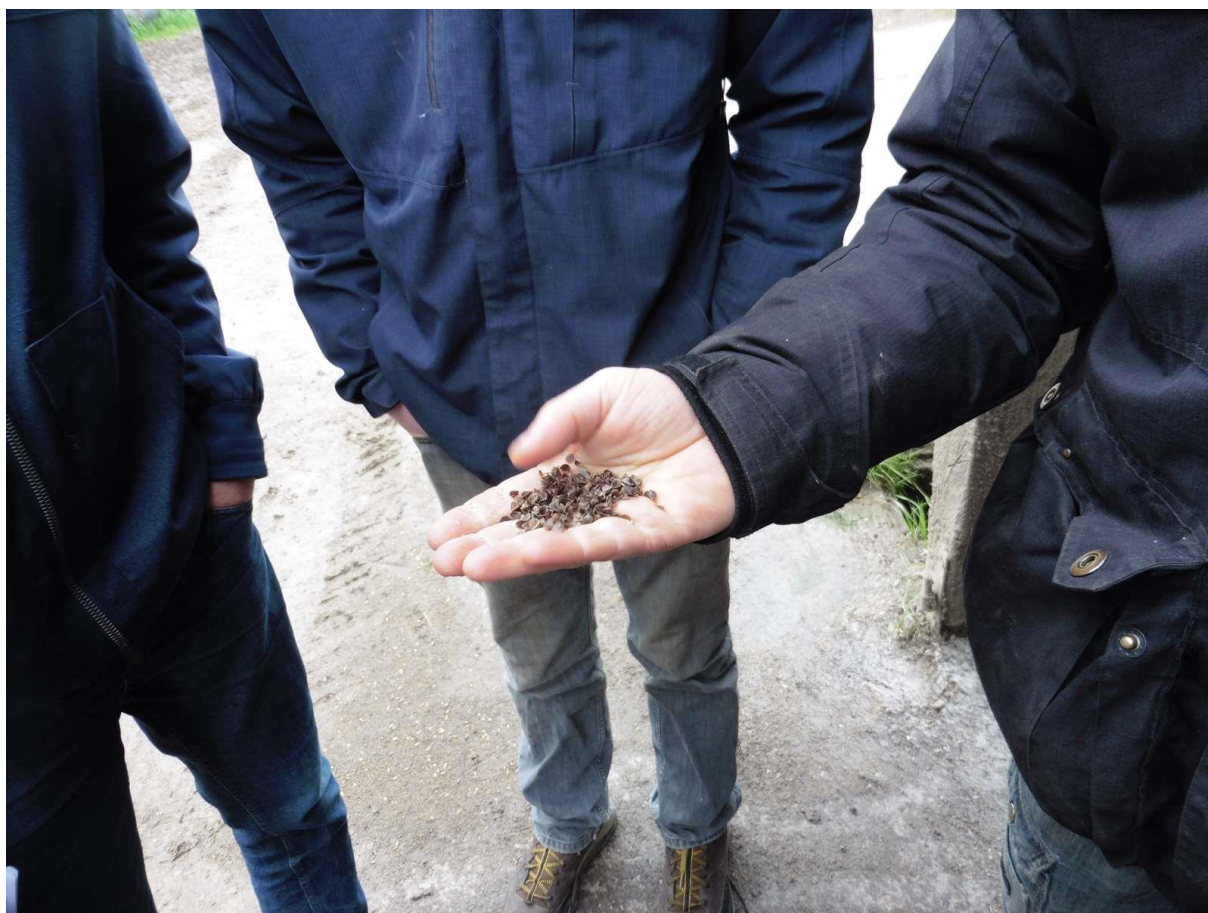
The oil press costed 5000-6000€.

Prices and evolution of markets

Farmer B sells 10 kg or 25 kg bags of flour and seeds to bakers, organic shops or CSA. He sells dehulled buckwheat at 4.5€/kg to organic shops (exactly like Farmer A on the first farm). As

Farmer A, he agreed that this price is really the lowest possible and should be increased to be more profitable.

Farmer B thinks that the market is growing but is afraid by big industrial players who are more and more willing to enter such markets. So there is a need to reflect on the right scale of processing operations and to whom is getting the added value. They know a farmer's association called *Grenier Bio d'Armorique* (GBA, <https://www.produire-bio.fr/articles-pratiques/les-greniers-bio-darmorique-des-producteurs-de-cereales-bio-se-reapproprient-leurs-filières-dans-louest/>), which involve 40 farmers and deals with local businesses for collecting, processing and retailing of naked oats, spelt, buckwheat, wheat, and starting with hemp. Their products are processed by *Céréco*, a Breton food company created by a farmer and specialised in organic breakfast products which supplies a wide network of organic shops all over France. GBA and Céréco have developed a multiple year contracting system. There is a range of possible prices which are dependent on the quantities produced. On bad years with low quantities, the prices are high and on good years with higher quantities, prices are lower but with a guaranteed minimal. This systems aims to support a stable and satisfying income for farmers between years. This association was created by farmers and want to keep the right scale to keep respect farmers' interest.



Dried buckwheat before dehulling



The cleaning and drying building



The Heger (Moulins d'Alma) dehulling centrifuge and the winnowing machine below (Tarare) used for the first wind screening



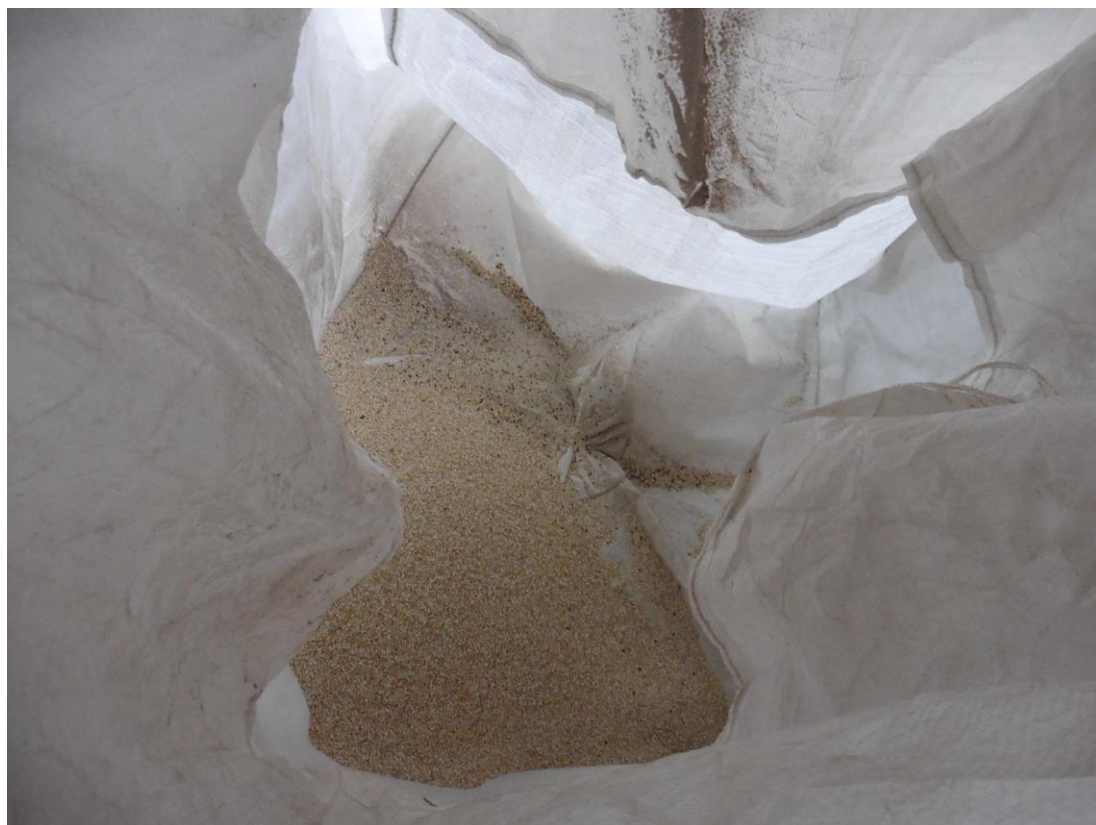
The winnowing machine below (Tarare) used for the first wind screening



The mechanical screening using moving grids for the second screening after dehulling



Sorting the dehulled seeds, unde-hulled seeds, broken seeds and hulls in the iterative dehulling process



Buchwheat hulls



Mix of dehulled (bright) and un-dehulled seeds (dark) before optical screening



Explanations about the optical screener



The optical screener



The farm label for dehulled buckwheat seeds

Summary of the different steps of dehulling buckwheat on farm B

