### **Curaíocht an Phobail EIP Project:**

LLOC5018: TO PROMOTE A ROBUST, RESILIENT, ECONOMICALLY VIABLE AGRICULTURAL INDUSTRY IN NW DONEGAL

## **Final Report**



Togra Curaíocht an Phobail – LLOC5018

Cill Ulta – LAN Ctr

An Fál Carrach

Co. Dhún na nGall

Phone: 074 91 80994

Email: cillulta@gmail.com

Website: <u>www.cillulta.ie</u>









## **Curaíocht an Phobail Final Report**

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#### 1.0 Executive Summary

Cloich Cheann Fhaola is a Gaeltacht community located in the extreme NW of Donegal: - it suffers high levels of out-migration, unemployment, and a disproportionately aging demographic (POBAL, 2016), including the necessity for social inclusion especially with regards to the farming community; the mean annual earnings for Donegal from 2016 to 2018 were consistently the lowest in the state ranging from €32,000 to €34,000 (more than €10,000 below the state average (CSO, 2018). Interestingly, in Sept 2022, the EU in the downgraded the North and West of Ireland to a "lagging region" after becoming significantly poorer relative to the European average over recent years.

In NW Donegal, a land which was once covered in oats, cabbages, and other feed and fodder crops; grazed cattle and sheep farms now account for 87% of agriculture (CSO, 2010) with less than 1% of lands under cultivation (unpublished survey of land use within local SPA, 2017). With 2019 reports showing that just 18% of cattle farms and only 23% of sheep farms are economically viable (Buckley and Donnellan, 2020), single farm enterprise has brought agriculture in the region to its knees. Of the 9,240 farms in Donegal, 63% earn less than €8,000 per annum (CSO, 2010).

Rejuvenation of sustainable, mixed-farm enterprise through the promotion of cultivation could reinvigorate the local economy. However, what we have discovered through Cúlra Créafóige EIP is that while the collective memory of cultivation still exists within the community, the technical skills and suitable machinery for small farm holdings that have been lost in time. Most of the modern cultivation equipment available is not suitable for smaller holdings which are in existence throughout the North West Donegal. The Curaíocht an Phobail project presented the opportunity to provide the technical expertise required to re-train local farmers in ecology, biodiversity, sustainable agriculture, and most importantly, sustainable use of farm machineries and the incorporation of circular farming practices utilising a short supply chain, a low carbon footprint and promoting and supporting local businesses in the region. Preparing the community with the necessary skills and awareness is the critical first step in changing the local mindset and guiding the development of a sustainable cultivation industry, becoming leaders in supporting the EU Green Deal, Circular Bioeconomy Strategies, whilst furthering the knowledge learned from Ireland's Farm-to-Fork Strategy, and enhancing that concept of from soil to human health, implementing Irelands Climate Action Plan; as well as the Gaeltacht Glas; farming while creating wildlife habitat; supporting the regeneration of soils and carbon sequestration; reducing compaction and erosion; improving water quality, water retention as a valuable resource; and providing for the economic and social stability of the region.

Table 1. Summary Table Curaíocht an Phobail EIP Project

Start date:	01.01.22	
End date:	18.11.23	
Budget:	€162,200.00	
Number of farmers:	36	

Curaíocht an Phobail EIP addressed these issues by promoting sustainable farm management methods in NW Donegal which champion sustainable practices and complied with emerging changes to the CAP 2023-27.

The training of a cohort of farmers, inclusive of both sexes and a key farmer from Arainn Mhór island, in ecological cultivation methods ensured: - vital skills exist within the community; encouraging financially resilient mixed-farm enterprise and possibly out-migration; addressing land abandonment; supporting a sustainable approach and all aspects of farming, including the use of light weigh machinery and the establishment of a circular Bioeconomy economy. Trust and confidence built within the farming community in the region, was fundamental to realise the project from commencement to the final outcomes.

Supporting the Preab San Úir youth programme provided a means for the local youth to reconnect with their rural cultural heritage, encouraging pride-of-place and responsibility for sustainable land management, and to demonstrate modern, sustainable agriculture as a viable and fulfilling career.

#### 2.0 Brief description of the project

Farms which produce both animals and crops use animal waste to feed the crops which are grown to then feed the animals, creating a vast reduction in our need to import both fertilizers and animal feeds: re-claiming control over our food security and food sovereignty, and keeping much needed funds within the Irish economy. Encouraging farmers to grow their own animal feed will also help us to cover vast distances on our way to a zero-carbon society. One hectare of Irish grow animal feeds produces just 1.18 tonnes of CO2 equivalent while one hectare of South American grown animal feed produces as much as 27 (Teagasc, 2020). Ireland should be looking forward and planning for a future; for our economy, for our community, and for climate change.

The initial start-up timeframe was pushed back due to difficulties in earmarking a suitably qualified Agri-Ecologist – 3 attempts were made to widely advertise the role; while the role was offered in August 2021, the prospective applicant declined. Other options were explored: to break the project into individual work packages and to contract on work package basis. While deemed not the most practical way forward, it was considered, however, a suitably qualified person came on board as Coordinator from January '22 to oversee the roll-out of year program. The issue of readily availability of agri-ecology skills set in general needs to be addressed by government.

A cohort of 4 key farmers where secured and they in-turn enrolled up to 10 farmers each to participate in the project. Each farmer was assigned a budget of €1000 to pay for materials and goods to improve the sustainability of their farms. The four core aims of the project came under the headings of Farm Diversification, Water Quality, Bird and Pollinators and Farm Boundary Management. Each participant was required to select an action from within each of the four headings: - this included clover establishment, stone wall repair, seaweed liquid fertilizer to replace chemical Nitrogen, landscaping of ponds, planting of native trees, creation of an orchard, the purchase of livestock (pigs, chickens). Once the farmers choose their list of actions, the Co-ordinator then visited each farm land to discussed the actions suitability and to plan the agreed actions roll-out. In addition to implementing these actions, they were also required to attend 6 guest speakers specialised training sessions which included: - soil health; agroforestry; growing with heritage seed; improving water quality; sustainable land management; alternative crops for upland farming; and reduction of invasive species.

Each key farmer received action-based payment up to €500 per farmer engagement and advisory services. The Agri-Ecologist Advisory Co-ordinator's role was to engage and support key farmers, visit lands, agree that farm actions are in-line with the project. This part-time role was supported through office-based administration and horticultural support.

#### 3.0 More detailed reporting to address

#### 3.1 Baseline Data

Due to a prevalence of sheep farming the majority of the participant farmers struggled with soil compaction, the overuse of nitrogen fertilizers and the growing of a monoculture of rye grass. Fortunately, with the combining influence of the awareness of the incoming changes to the CAP policy, with emphasis on habitat restoration, water quality, etc., the inclusion of sustainable methods on farm / land management was support y traditional farming methods, presented a positive attitude from participants in engaging with the project and implementing sustainable actions on their land.

Fig.1 Extensive variety of farms from the Cloich Cheann Fhaola region including upland and coastal lands participating in project.



Poor soil quality, whether peaty or highly acidic compacted earth is a result of a fifty year legacy of overgrazing, overstocking and pesticide use. The realisation of these conditions by the farmer was also an impetus to convert, on a trial basis, to a natural fertilizer. As well as a changing mind-set of working with their land, i.e., where the land was permanently wet, introduce a pond for wildlife; where the topography was uneven and unworkable, plant native trees; planting native hedgerows to replace fencing.





Fig.3 Native trees planted to enhance fence boundaries.



#### **3.2 KPIs**

The Key Performance Indicators (KPIs) are based on the actions required to be delivered by the project partners to establish baseline data and implement a range of activities that eliminate damaging activities and start the process of restoring sustainable land management. The KPIs, documented in the status review reports and associated results are detailed below.

#### 3.2.1 Objective 1: The replacement of artificial fertilizer for a more natural approach.

KPI: Identify the level of the intensive use of nitrogen fertilizer with the support of farm advisors. Introduce the option of spraying with seaweed liquid fertilizer as an action to improve soil health and improve ground water quality.

**Target:** Implement spraying with seaweed liquid fertilizer twice annually with end of year foliage analysis to monitor improvement of grazing quality.

**Result:** As an exercise to win over the commitment of the farmer to continue with natural fertilizers beyond the timeframe of the project, test segments of their field were sprayed with seaweed liquid fertilizer. As the cover grew throughout the season, it was visible for them to see the hugely improved structure and quality of their grass which gave the essential and practical evidence for them to make a permanent change to a nature-based solution. The huge price jump in chemical fertiliser due to the Ukraine war also made farmers really enthusiastic to trial this measure.

Fig.4 Seaweed sprayed on pasture and subsequently rolled by the participant.



## 3.2.2 Objective 2: Introduce the growing of a mixed sward and a clover rich pasture to enhance soil health, animal health and increase biodiversity.

**KPI:** Increase use of seeding fields with Multi Species Swards or Clover as a replacement to rye grass and share knowledge of the positive outcomes of this practice for both soil structure and livestock. **Target:** Adapt seeding practices that will support a biodiversity rich landscape and a reduction on the

reliance of chemical Nitrogen.

#### Result: Baseline data

With the support of the Agri-Ecologist and farm advisor, the transfer of seeding with mixed sward and clover was accepted as a positive action by farmers. Although the farming community were aware of this prospective change to a preferred grassland, the trial of sowing with mixed sward and clover made for a convincing experience. It was evident that livestock were not hindered and the increase in flora supported invertebrates. The switch to this practice also fell in-line with changes to scoring of lands for farm payments. purchase of clover, chicory and plantain, delivered with no till drill seeder.

Fig.5 Mixed sward and clover test strips





#### **Wild Bird Cover and Field Margins**

Wild Bird Cover is a spring-sown crop that is left unharvested over winter to provide food for farmland birds. With specified guidance from the Agri-Ecologist the required area for seeding was a corridor 2.5m wide and min 50m long. Sowing consisted of a mix of cereal and linseed seed, cereal and mustard seed.

Field margins are the areas between the crop and the field boundary and in most cases they occur adjacent to hedgerows. The specified area covered 2m wide corridor from hedgerows or stone walls and 50 m long. These margin areas support and encourage an increase in biodiversity.

Fig.6 Wild bird cover corridor seeded with cereal and linseed.





Fig 6A-Unharvested field margins acting as wildlife corridors



#### **Shelter Belt Planting and Restoration**

Farmer participants were given native trees for shelter belt min 20 whips. An apple orchard was also an option were each farmer under Farm Diversification action who expressed a preference was given 5 apple trees. This action added to the farm diversification of upland small holdings. Stone wall restoration was also opted as an action ( min 70 m )

Fig 7. Shelter belts established and restored stone wall





3.2.3 Objective 3: To train a cohort of farmers in ecological cultivation methods; ensuring vital skills exist within the community, encouraging financially resilient mixed-farm enterprise, addressing land abandonment and out-migration.

**KPI:** The aim of the project is to reintroduce farm diversification to establish a sustainable practice of land management, improving habitat quality using a series of management options available. The first step is identifying requirement options, determine best suited and then implementation.

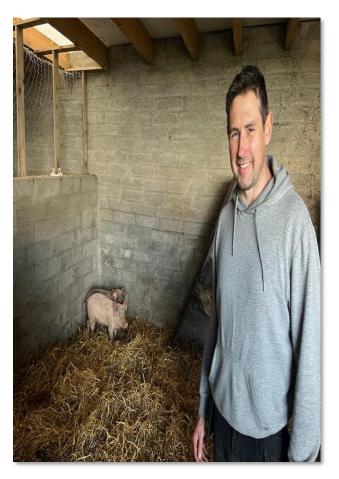
**Target:** The target is to implement the appropriate actions outlined in the project, enhancing the resilience of the farm to streamline with expected CAP policy.

**Result:** The proposed actions in this objective was to re-establish a sustainable balance to smallholdings and support the reconnection to living off the land and creating a robust farming community at a juncture of an increase in suburban lifestyle, whilst aligning farm management methods with imminent changes to agricultural policy.

#### Applying farm diversification by way of varied livestock and horticulture.

The varied activities on a mixed smallholding allow and encourage more biodiversity and of course, environmental benefits are far greater. This provided farmers with the opportunity to create suitable infrastructure on farm through the purchase of as hen houses, pig arcs and electric fence netting to control animals. The traditional Irish orchard was a very popular measure







#### Fig 9a Horticultural diversification



# 3.2.4 Objective 4: To improve farmer knowledge and local knowledge on positive changes in land management for nature.

**KPI:** Whilst the local farming community have a foundation in traditional farming, the disconnect over the last 40 years, the loss of knowledge and the use of invasive methods have left the farmer in a more vulnerable place. The training sessions where tailored to the needs of the farmer to make changes that would support the criteria for future payments.

**Target:** Introduce best practice in four categories; farm diversification; water quality; pollinators and birds; hedgerows, boundary walls and woodland.

**Result:** Seven training sessions were organised which consisted of a workshop and field trip. The topics covered; soil health, agroforestry, heritage seed, water quality, sustainable farm management, upland farming and invasive species. The facilitators, each with an expertise in their topic, were also invited to speak as special guests at public meetings which were open to the wider community. This provided a platform to discuss sustainable actions for land management which were expected in the coming year as part of new EU policy.

Fig.10 Dr. Steve Collins, Derry Duff Blueberry Farm and Aronia Ireland; field trip with participant farmers and landowners on cultivation farming in the uplands.



It was essential that participant farmers, and the local farming community, gain a deeper knowledge of the changes that would be required of them for future payments, for their own benefit, but also for the benefit of our local ecological landscape. Each training session focused on creating a broader understanding of why certain actions were being introduced, how this supported the natural habitat and wildlife, but also added a higher nature value to their farm / land. Topics such as, soil health, agroforestry, heritage seed, water quality, sustainable land management, upland cultivation farming, invasive species, where delivered in a knowledgeable and practical way. Farmers were given the opportunity to get 'hands-on' with all aspects of the nature-based solutions offered by the project, applying these methods to their own lands to test and confirm the outcome. These training exercises also gave a chance to normalise new terminology that farmers would be introduced to through new scheme requirements.

Fig.11 Jimmy Mc Veigh, Local Authorities Water Programme, field trip with participant farmers and landowners on water quality.



Fig.12 David Wallis, DANÚ EIP, field trip with participant farmers and landowners on soil health.



This level of engagement with farmers and landowners proved to re-invigorate interest in managing their land well and inspire an interest in increasing their knowledge on ecology. A balance was achieved through a cross-over between innovation and traditional knowledge. Given the impact of the enforcement of invasive farming methods in the past 50 years, it was evident that with a little support and encouragement, farmers still retain a sense of care and responsibility to the land and have an active interest in improving their farms.

#### 3.3 Closing Evaluation

This project worked with members of the local farming community in Cloich Cheann Fhaola to engage them with sustainable farm management. A table of select actions was drawn up targeting four specific goals to address making changes on the farm to increase its high nature value. The four goals were: - Farm Diversification; Water Quality; Pollinators and Birds; Hedgerows, Boundary Walls and Woodland. These actions when completed would also benefit the farmer with future scheme payments.

Four key farmers were recruited by the project, firstly to disseminate the goals of the project and enrol ten farmers each to participate. This approach proved very successful as the key farmers, being part of the local farming community themselves, already had an established relationship. Each farmer was allocated a budget of up to €1000 euros to carry out their choice of four actions from the four specific goals that were drawn up by the project. 37 farmers, excluding the key farmers, benefited.

The majority selected to have their land fertilized with liquid seaweed, this gave them an opportunity to trial a more natural method, which has resulted in a positive shift away from synthetic fertilizer. Many have reported a significant change in soil structure due to the sowing of multispecies sward and clover.

The addition of native trees and hedgerows will have also benefited the farmer hugely with the scoring of their land under the new ACRES scheme. This action will contribute to an increase in biodiversity and wildlife on their lands benefitting the wider region.

A greater achievement of *Curaíocht an Phobail* was to allow the local farming community to determine whether these actions had a positive outcome for themselves. By giving them the opportunity to trial certain changes, of their own autonomy, whilst being supported by their key farmer and Co-ordinator, a change of attitude and an eagerness to continue to include sustainable farming methods has evolved. The participating farmers have approached us with a simple question *'What's next?'* 

#### 3.4 Value for Money (VFM)

Curaíocht an Phobail LLOC5018, funded under the European Innovation Partnership Programme, provided the opportunity for farmers in an upland rural community, to carry out trials which demonstrated the benefits of a circular biological environmental-friendly and economically sustainable practices. The project offered good value for money, in offering farmers an opportunity to make changes within a recognised collective, where they felt secure in their decisions and has engaged their interest in making more positive changes. The results of these actions can only be measured in the coming years as biodiversity and wild birds will hopefully repopulate. In the interim, farmers will feel rewarded by an increase in 'land scoring' from the ACRES scheme. This project ignited an interest and hunger in a remote upland farming community, where farm life was dwindling. These positive actions will hopefully have a lasting effect to continue with sustainable methods as the reintroduction of suitable machinery and farm diversification supports the circular economy and the prevailing natural world.

LLOC2016 Cúlra Créafóige EIP which preceded Curaíocht an Phobail and which was being delivered alongside same, laid the ground work in terms of awareness raising and participation: - the clearing of abandoned land and a fresh invigoration to farming potential in the area; this opened the possibilities to learning new methods while incorporating older knowledge. In this context, Value for Money was delivered for Curaíocht a' Phobail in the following ways:

- no administration running costs i.e. electricity, phone, etc.
- Cill Ulta's staff supported Curaíocht an Phobail in terms of expertise and ongoing back-up resources especially in relation to upland conditions;
- the project placed emphasis on the local circular economy which added to the value for money aspect, especially in the area of the provision of natural fertilizers (liquid seaweed) while global conflict impacted prices, and Climate change;
- maximising training through training costs being covered 50% from both EIPs; and
- the expertise of the Co-ordinator meant there was no 'lead in' time and when the project finally restructured the delivery mechanism, it hit the ground running.

The project liaised closely with the Operational Group and all proposed works and actions were discussed to determine the best value for money.

#### **4.0 Financial Report**

*Curaíocht an Phobail* had the benefit of being administrated in conjunction with LLOC2016 Cúlra Créafóige in which specialised training costs were supported by each project and therefore, achieved value for money for both projects.

There were initial concerns around the delivery capacity of the overall budget when we failed to earmark an overall fulltime Co-ordinator and therefore, had to restructure the delivery mechanism: however, it made for a much more successful project as the calibre of the part-time Agri-ecologist Co-ordinator was recognised by the local farmers who quickly bought in; the project would not have managed to engage the equivalent on a year full-time basis. It must be recognised that without the EIP DAFM support team, and their dedication and flexibility in their project delivery approach, we would have not achieved as much as we have.

Due to the fact that Curaíocht an Phobail emphasis was on the local circular economy and short supply chains, the input of local suppliers was lower and, therefore, the benefit to farmers was significant. Cill Ulta was able to introduce small machinery through Curaíocht an Phobail, which is much more land-sustainable and ecologically friendly. This machinery will remain with Cill Ulta for local farming use in the coming years.

The overall Curaíocht an Phobail budget was as follows: -

**Table 2. Total Project Expenditure** 

PROJECT COSTS	Budget €	Actual Spend €
ADMINISTRATION		
Set-up Costs	1,500	1,070
Management	5,000	8,785
Financial Administration	5,000	7,665
Administration Meetings	2,232	462
Bank Charges	-	68
	13,732	18,050
	8%	11%
PROJECT SUPPORTS		
Agri-ecologist part-time	15,000	11,895
1 FTE Farmers	20,000	19,000
Project Liaison part-time	15,184	24,749
Travel and Subsistence	1,000	
	51,184	55,644
	32%	34%
PROJECT IMPLEMENTATION		
Training	10,000	10,320
Implementation	31,000	25,269
Creation of Basic Sustainability Manual	1,284	2,621
Youth Training	5,000	6,000
• •	50,000	44,296
	97,284	88,506
	60%	55%
TOTAL COSTS	162,200	162,200
	100%	100%

#### 5.0 Lessons learned

The following were the main lessons learned from the project:

- Success of delivery depends on flexible, localised programmes
- The enrolment of local key farmers (4) who are part of the farming community is invaluable to obtaining a committed partnership from all participants (key farmers brought in 37 participating farmers, including an island community). Local farmers could relate to knowledge dissemination from the neighbours and peers. Of course, this relies heavily on a trust, conviction and confidence with participants.
- Upland and coastal smallholdings are a challenging topography to work with, requiring adequate measures with smaller machinery due to access and land type. The move to much larger machinery in the past 50 years has resulted in previously tilled farms no longer having crop rotations which reduces positive impact on diversity;
- Cill Ulta, and its farming community, now has at its deposal a range of small farming machinery more appropriate
  for upland cultivation supporting regenerative farming practice, supporting government environmental targets
  and actions;
- Youth participation was integral to include social inclusion as well as bringing lost knowledge in terms of cultivation to youth participants. This project reconnected that broken link between young and older generation:

   that connection between the land and its importance to sustain small communities with regards to food sovereignty, biodiversity and human health, mental health and lifelong knowledge that has been lost with the passing of time;
- Innovative practices need more expertise and provisions to support the region knowledge transfer will be important to sustain the community to support sustainable food production which includes research, development and innovation. Management of valuable resources and the use of circular biological practices will continue to support the region. Training workshops on local biodiversity, soil management and soil enhancement, soil health and structure should be further developed to continue to encourage farming practices that are recognised in future climate action plans, environmental strategies as well as An Gaeltacht Glas Strategy and Donegal County Council environmental and decarbonisation action plans.
- Due to current ecological goals, a revaluation of upland smallholdings as high nature farms would benefit and support the farmer to manage the land accordingly as well as find alternatives to support the farmer.
- Such small localised projects as EIPs can achieve a lot on the ground, not only through acquired goals, but in a
  broader shift of attitude and acceptance of incoming changes. A bottom up approach as demonstrated by this
  project proved effective in the farming community, farmers acquiring the knowledge and information as well as
  understanding the dynamics of the farm, the crops, soil, wildlife, resource management, circular economy
  concepts and biodiversity and how they can all work in harmony with each other to realise climate adaptation
  and mitigation.
- Application of Seaweed fertilizer proved to produce an outstanding result for grassland and reaffirm that traditional methods, that are within living memory, were based on long standing indigenous knowledge. Local seaweed fertiliser supported the short supply chain, and low carbon footprint as we as demonstrating circular Bioeconomy economy on the farm.
- Application of a seed source in association with preventing rabbit grazing was successful and has a roll in future habitat management on Machair.
- Increasing public awareness does result in a greater interest in the health of the land and the preservation of surrounding wildlife and biodiversity. The farmer is increasingly being held with higher regard for their contribution to local land management. Inclusivity of both male and female, along with an island community, made the process of inclusion very important with increasing public awareness, as people were more forthcoming with questions, training workshops and information sessions.

#### 6.0 Actions to carry forward

The work completed under Curaíocht an Phobail will contribute to farmers engagement under the new Donegal ACRES project. A number of the farmers have entered the new scheme. Within this a results-based scoring scheme will be implemented and work with the farmers to carry out more actions to continue improvements on their lands. This will be aided greatly by the existing work completed.

CIII Ulta's contribution in supporting the local farming community will continue and work with the local community to improve awareness. Future projects will be founded on the integration of indigenous knowledge combined with new innovations.

Preab San Úir, the Summer youth programme, also had a role within the EIP projects to carry out biodiversity surveys of the participating lands. This practical hands-on experience will foster a future interest in local sustainable land management within our youth.

Cill Ulta was able to introduce small machinery which is much more sustainably land and ecologically friendly through the purchase of same in Curaíocht an Phobail . This machinery will remain with Cill Ulta for local farming use in the coming years.



Fig.13 Preab san Úir, Summer Youth Programme, conducting worm surveys on local lands.

#### 7.0 Details of dissemination of project findings -

The core objective was to create knowledge dissemination to the participant farmers from the Agri-Ecologist, the core farmers and expert speakers from the additional training sessions. To enhance community involvement, open meetings were hosted each night after the farmer training workshops were completed. Local residents, schoolchildren and interested parties with specific interest in some of the training modules could participate. This led to a feel-good factor from the local community and raised interest in the project. It was transparent that farmers in their region were going above and beyond to enhance water quality, biodiversity and improve farmland habitats, raising much needed awareness in the circular economy, environmental well-being as well as enticing activity on local farms to promote healthy lifestyles and improved mental health.

The project has also worked closely with the new LIFE on Machair project and Wild Atlantic Nature. LIFE on Machair project aims improve the conservation status of Ireland's Machair grassland and Fixed dune habitats and the ecological conditions for breeding waders and pollinators on a number of Machair sites. The project will run over the course of six years, from 2022 to 2028. Wild Atlantic Nature focused on peatland habitats and both Catherine Farrell Wilkie and Victoria McArthur, the project liaison officers, have both shared experiences from farmers within their schemes. Many participants within EIP Curaíocht an Phobail have these habitats present on their lands.



Fig.14 Jimmy Mc Veigh, Local Authorities Water programme, hosting workshop for participant farmers.

#### Water Resource Management

Climate change has affected every aspect of the natural environment including water. Sustainable water management is central to fighting climate change, to building resilience of societies and ecosystems and to reducing carbon emissions. Everyone has a role to play to reduce the effects of climate change and this project gave us opportunity to reach out to the farming community and to raise the importance of water resource management. There is an urgent need to manage water and protect local water supply to farms and livestock and how we use water to water our crops. Rain water harvesting with a UV Filtration was demonstrated by Cill Ulta to the local farming community and we demonstrated the circular economy in action. It is important that we can demonstrate this the implementation of the EU Water Framework Directive, and advice and collaborate on appropriate measures to take to manage water and understand water resource management.