Fisheries Local Action Group Zalew Zegrzyński
Fisheries Local Action Group „Mazurskie Morze”
Fisheries Local Action Group Lappi

Fishing Intelligently

Ecological, Economical and Social Effects of Non-selective Freshwater Fishing Method

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INTRODUCTION: "FISHING INTELLIGENTLY – FIN" PROJECT

„Inteligentne rybactwo"/"Fishing Intelligently" project, acronym: FIN, is being implemented by three Fisheries Local Action Groups (FLAGs) that are a part of the following Local Action Groups: two Polish ones, namely Zalew Zegrzyński and „Mazurskie Morze", and a Finnish one called Leader Pohjoisin Lappi.

Participants of the „Fishing Intelligently" project kick-off meeting, Serock, Mazovia, April 2019

Project Target Groups

Direct and indirect target groups can be identified in relation to FIN project's objectives and activities.
Direct target groups include:

- freshwater commercial fishermen in Poland and Finland, benefiting from better environmental conditions for development of fisheries, better quality and higher quantity of catch;
- segments of fisheries areas' communities, which are economically dependent on fisheries sector's activities.

Indirect target groups include:

- communities within the entire fisheries' areas, visitors and other entities, benefiting from better condition of local natural resources and related socio-economic development (i.e. tourist businesses)
- local authorities responsible for and organisations interested in protection of natural environment
- all European stakeholders interested in the positive environmental and economic impact of non-selective fishing methods.

Project Objectives

A direct objective of the "Fishing Intelligently – FIN" project is promotion of non-selective method of inland fishing through exchange of experience and good practices between LAG Leader Pohjoisin Lappi (Finland) and LAG Zalew Zegrzyński and LAG „Mazurskie Morze" (both Poland).
This fishing method has more positive impact on the environment as well as on the condition of caught fish than a selective fishing method. By upgrading the water conditions and quality of the catch it also contributes to overall performance of the fisheries sector and, eventually, to development of the fisheries areas.

Non-selective fishing training participants. Lokka, Lapland, July 2019

Non-selective fishing training. Lokka, Lapland, July 2019

Project Activities

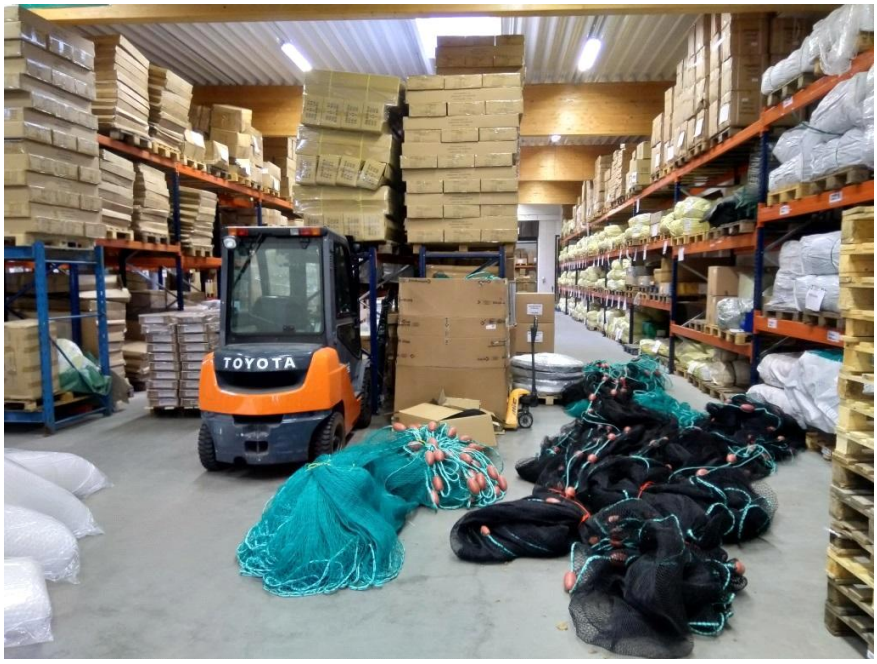
Essential “FIN” project activities include: training of Polish fishermen-trainers in Lapland, production and purchase of non-selective fishing gear, training of a wider group of Polish fishermen in Poland (by previously trained trainers), elaboration and distribution of a brochure on non-selective fishing methods, “Fishing Intelligently” conference to address ecological aspects of freshwater fisheries.

A visit at a fishing gear production facility

Assumed Results

Assumed project results include:

- knowledge and skills of non-selective fishing method acquired by fishermen;
- raised Polish, Finnish and other European fishermen' awareness of environmental impact of particular fishing techniques;
- improved well-being of fish stock;
- improved quality of marketed fish;
- increased sustainability of fisheries in areas, where non-selective fishing method is applied;
- improved condition of the water environment, where a non-selective fishing method is applied.



Commissioned non-selective fishing gear has arrived

Timeframe for "FIN" Project Implementation

Planned timeframe for the "Fishing Intelligently – FIN" project was fifteen months and ran from 1 April 2019 until 30 June 2020. As of the moment of elaboration of this brochure (April 2020), with the ongoing pandemic of COVID-19, we have to assume that project implementation time has to be extended.

ECOLOGICAL FISHERIES

FISHING ECONOMY IN THE AREAS OF FISHERIES LOCAL ACTION GROUPS (FLAGS) – "FISHING INTELLIGENTLY- FIN" PROJECT PARTNERS

Fisheries in FLAG Zalew Zegrzyński area

Fishing activity in FLAG Zalew Zegrzyński area is carried out by the Mazovian Ward of Polish Angling Association (Okręg Mazowiecki Polskiego Związku Wędkarskiego – OM PZW). PZW selected as a result of a bid, is a user of a water body which constitutes a part of the „Zegrzyński Reservoir on Narew River no. 7" fisheries district. The district area on Lake Zegrzyński within FLAG boundaries is 2 400 hectares. In addition, it includes Narew and Bug rivers (partly also in FLAG area), Żerański Canal and smaller streams and reservoirs outside FLAG area. PZW has a fishing base in Wierzbica on Lake Zegrzyński (Serock Municipality) with decks, storage facilities, cold stores and office space.

An estimated number of fish species in the district's water bodies is 38, out of which as many as 23 are of utilitarian value. They include eel, although it is not numerous. Migrant fish, after a dam in Dębe was built, find migrating in the district's waters rather difficult. Bringing the fish back to the area's fish realm requires making their upstream migrations easier (clearing river beds, building fish ladders, etc). This in turn calls for collaboration of various river users within the Vistula water system.

Protected fish species, present in the area, include: spined loach (Cobitis taenia, weatherfish (Misgurnus fossilis), bitterling (Rhodeus sericeus), spirlin (Alburnoides bipunctatus), bearded stone loach (Barbatula barbatula). Protected are also European river lamprey (Lampetra fluviatilis) and Ukrainian river lamprey (Eudontomyzon mariae), which are not considered as fish. Alien species in the area include: amur (Ctenopharyngodon idella, Mylopharyngodon piceus), carp (Cyprinus carpio), silver carp (Hyphothalmichtys molitrix) and Prussian carp (Carassius gibelio). Also striped crayfish (Orconectes limosus) and European crayfish (Astacus astacus) can be found, albeit rarely.

The OM PZW fisheries management consists of utilising waters for fisheries and angling purposes in line with biological conditions. This includes systematic stocking of water bodies. The value of stocking fry in 2019 was over 4 million PLN including 1 million for the Zegrzyński Reservoir. Net catch structure by species is dominated by these, which are typical for eutrophic waters (white bream, common bream, roach). This proves a high level of degradation of Lake Zegrzyński waters.

Anglers' catch is rather high - it amounts to at least 30 kg/hectare annually. As predatory species represent some 30% of its volume it may constitute a danger for this category of fish. Therefore, protection measures are required for this group (protection of spawning conditions, stocking, catch limits), which is important for maintaining biological balance. Also, increased catch of less valuable, cyprinid fish is needed in order to remove a big load of biogenic material, which contributes to degradation of water quality.
Bio-manipulation, which consists of systematic clearance of cyprinid fish in connection with intensive stocking of predatory species, is an effective method of improvement of water environment conditions. It is particularly true for water bodies exposed to strong anthropogenic pressure and in

danger of fast eutrophication like big lowland barrage reservoirs. Such reservoirs have a very high production potential. In other words – they offer conditions for dynamic development of the population of fish with low environmental requirements. In our conditions this group consists mainly of cyprinid fish including roach, white bream and common bream. Leaving this type of water body without a fish stock management plan is detrimental to the environment. It leads to speeding up of the eutrophication process, which results in intensive algae blooming and accumulation of sediments, which in turn causes periodic oxygen deficits and massive fish kill. Additionally, congestion of fish leads to numerous parasite diseases (like tapeworm or nematode worms) as well as bacteria and mycosis diseases. Prevention of these negative phenomena requires well-thought out and targeted fishing practices with use of fishing gear dedicated to specific fish species in order to maintain their balance.

Temporary summer oxygen deficits and bacterial contaminations are occasional problems, which challenge the fisheries sector. They are a result of run-off of biogenic material from fields and meadows and water pollution caused by sewage. Another challenge is the fact that Lake Zegrzyński functions not only as a fishery, but also as a source of water for Warsaw, a recreational venue of various types, a source of electric energy and an element of a flood prevention system.

Fisheries management has been carried out by the OM PZW on the lake since it was created. Recent stocking activities have a purpose of reshaping fish stock towards a higher share of predatory species.

Net fishing is extremely important with regard to this objective. It makes possible removal of cyprinid fish, which due to high numbers, contribute to the lake's eutrophication. Net fishing is a counterbalance for recreational fishing, in which anglers focus on valuable, predatory species, which results in excessive catch. At the same time cyprinid fish are underexploited, they feed excessively with plankton organisms, which would feed with (remove) algae causing algal bloom of water. This shows how important the freshwater fisheries are for protection of water ecosystems. Regulatory effect of net fishing can be increased by application of appropriate fishing gear.
The OM PZW fish stock management in recent years consisting, on one side, of very intensive stockings with predatory fish species and, on another, on limitation of population of cyprinid fish, aims at transformation of species' composition towards bigger share of predatory ones, which benefit the water quality and are in more demand by anglers. In this manner the OM PZW fisheries policy supports short and long-term needs of anglers by preventing eutrophication and maintaining good living conditions for the fish.

Enabling fish migration is an important factor for proper functioning of water ecosystems. Reproductive migrations of fish can be divided in a simplified manner into spawning migrations of single environment fish and dual environment fish. In the first case migrations allow reproduction in optimal spawning locations. Additionally, they are necessary to maintain the diversity of the gene pool. In the second case migrations allow fish to get from rivers and lakes to the sea (for eel, which is endangered species) or from sea to rivers and streams (salmon, trout – *Salmo trutta* and sturgeon) for spawning. A dam in Dębe, which created the reservoir, constitutes a very serious barrier for migration. Existing fish ladder has many defects and does not perform its role.

Fishing base of the Mazovian District of the Polish Angling Association in Wierzbica at Lake Zegrzyński

There are in total seven 2-people brigades that perform fishing activities in Lake Zegrzyński. Their annual catch is about 20 tons of fish, which are sold to inhabitants of the area, as well as visitors.
Maintaining and, in particular, development of professional fisheries require additional investment in this activity, as well as developing auxiliary sources of income to increase the sector's profitability.
As European experience proves, also from countries with clearly beneficial conditions for freshwater fisheries like Finland, this type of fisheries can hardly stand competition with freshwater and sea fish breeding (aquaculture). Mixed fish husbandry composed of fish breeding and net fishing combined with recreational fishing (angling) can be a solution providing bigger value added. It requires development of eco-friendly tourist and angling infrastructure (decks, parking lots, garbage containers, boat sewage discharge points etc.)

Fisheries sector in Poland doesn't function in a vacuum and its development will depend on, along with the economic factor, a number of other elements: both external, which is independent from fisheries entities in FLAG Lake Zegrzyński area, and internal which the sector entities may have an impact on.
According to representatives of the sector, development of fisheries in the FLAG area requires a definition of hierarchy of functions, ecological, economic and social ones, of Lake Zegrzyński and small water bodies around it. This could contribute to better control of rather exuberant process of settlement and related investments, which has a negative impact on quality of waters (stronger resistance to urbanisation pressure in shore area, control of waterfront tourism and construction development).
Other necessary measures include a better control of angling pressure on the lake and its tributaries and limitation of poaching. Purchase of a 4x4 truck and a powerboat for the Voluntary and Professional Fisheries Guards, financed by the FLAG Lake Zegrzyński, will definitely increase effectiveness of these measures.
Also a need for better control of water pollution caused by sewage and solid waste is indisputable. It could be achieved by creation of a monitoring system for surface waters and other elements of natural environment (including voluntary actions), extension of sewage network, biological sewage treatment plants, completion of sewage collection ring around the lake, cutting down littering, promotion of ecological equipment and products.

To meet all those needs, a higher level of Lake Zegrzyński supporters and more active cooperation of all responsible entities are required. The latter ones include i.a. Polish Waters, Regional Directorate of

Environment, local governments, but also possibly the highest number of other stakeholders and users.

It is vital to spur a long-term community commitment for sustainable use of FLAG Zalew Zegrzyński waters and its territory. It can be achieved through stronger presence of ecologic issues in a broad education system, including those which relate to local waters, as well as raising understanding of ecology of water systems among users of water bodies. This includes raising interest of some local authorities in keeping their municipality waters clean.

Only such a complex, holistic approach, combined with increased investment in fisheries sector entities will make long-term, sustainable development of the FLAG Zalew Zegrzyński fisheries possible.

Fisheries in FLAG „Mazurskie Morze" area

An area of FLAG „Mazurskie Morze" belongs to the Regional Water Management (Regionalny Zarząd Gospodarki Wodnej) in Białystok responsibility area. There are 110 fisheries districts within the FLAG area. Most of them are in long-term rent. Five big fisheries sector entities are tenants of almost all of them. They include four private companies and the Fisheries Unit of the Polish Angling Association (PZW). They rent in total some 25,000 hectares of waters, which constitutes over 93% of all waters in the FLAG area. The remaining part is rented mainly by individuals.

Analyses of the Institute of Inland Fisheries show clearly a constant and deep drop of volume of catch in the Warmia and Mazury region since 1999, although a conjuncture in fish market should be taken into account while interpreting this phenomenon. It should be stressed that exploitation of many fish species through fisheries is currently unprofitable and that planned systematic stocking plays an important role. It is being estimated that the total annual fish supply (professional fisheries plus aquaculture) volume is 267 tons.

Bream is a species, which dominates in supply, followed by carp. Roach is another species available in large quantities. Pike occupies the forth place on the list. The first five are closed by rainbow trout. Other species of economic importance are perch-pike, eel, perch, tench, vendace and smelt. A fish farm sturgeon is an interesting case; while in 2008 it didn't exist on the market, five years later its supply was over 5 tons.

Small wholesale firms are the main customers of the FLAG area fisheries sector. They supply significant quantities of its catch to local markets, either through door-to-door trade, fish shops and fish eating places. All fisheries entities use this distribution channel. Direct sale of fish "from the boat" is another, relatively important, channel.

Sale of fish is still a main source of income for the fisheries entities. Fish processing has a limited scale, usually for their own needs i.e. smoking, filleting and disembowelment. However, a significant part of income comes from other activities, first of all from sales of angling permits, but also from fish processing, tourist and gastronomic services, various types of compensation and special fisheries subsidies. Two entities are involved in trout and carp breeding and have hatcheries.
Surveys of anglers in Gospodarstwo Rybackie Ltd. in Mrągowo show that two main species in anglers' catch are perch and pike, which represent some 40% of total caught fish weight.

As mentioned previously, stockings are one of the most important elements of complex fish stock management. While in 2008 fisheries entities in FLAG "Mazurskie Morze" area introduced fry worth some 630,000 PLN, in 2019 its value was nearly 998,000 PLN. The stocking value constitutes some 30% of the catch value.

Gospodarstwo Rybackie „Śniardwy", base of the Głodowo fishing brigade

Professionalization of the fisheries activities, experienced human resources, possibility of own production of fry and good knowledge of the local market are considered to be main assets of the fisheries sector by its representatives. They stress good organisation of the sector, with fishermen exchanging good practices and joint promotion of its products through partnership initiatives such as „Nasi Rybacy". A good track record of many years of cooperation between scientists, fishermen and local governments with regard to water protection and rational management is an opportunity to be used for the sector's development. This relates in particular to limiting the weak points of the area such as decrease of the fish stock due to unsatisfactory water quality, poaching and excessive population of cormorant.

In the present era fish exploitation can't be seen and carried out without consideration of remaining elements of the ecosystem as fish caught by professional and recreational fishermen constitute an integral part of it. In this context an attention should be drawn to a conflict of professional and recreational fishermen. Professional fisheries sector representatives underline a need for activities leading to Polish anglers' acceptance of the fact that angling is an integral element of management of fish stock. For many years, professional fishing was considered a factor which had the strongest impact on degradation of fish stock, while recreational fishing enjoyed "concessionary" perception. At present, scientists call for equal treatment of both forms of fisheries as potential causes of fish stock decline and perturbations in water ecosystems.

Eutrophication and gradual vanishing of lakes are considered as one of the biggest problems, both by fishermen and other inhabitants of the area. It is a slow natural process in which a lake basin is being filled up with sediments, gradually decreasing the volume of water. Human activity significantly speeded up that, otherwise lengthy, process. According to professor Ryszard Chróst research, commissioned by the FLAG, water quality and the trophic state of the biggest lakes in the FLAG area are worrying.

State of water has an impact on professional and recreational catch, as well as tourist attractiveness of lakes. Scientists and fisheries sector's findings show explicitly that eutrophication leads to succession of species in lakes. Selective fish exploitation, targeting mainly predatory species is an additional factor. These species are particularly appreciated by anglers with perch and pike being the favourite ones. The fisheries sector and other citizens indicate directions for actions, which may decrease the danger. They include: raising ecological awareness of local community, educating future anglers for respecting angler's code and proper record of catch, application of solutions decreasing water pollution, promotion of consumption of less popular species and law enforcement to eliminate poaching of fish.

With regard to retaining biodiversity level of FLAG area lakes' fauna, there is a need for protection measures which will result in preservation of endangered species, i.e. eel. Retaining a high biodiversity level of fish stock is crucial for maintaining the production potential of the fisheries sector in the FLAG area.

An appropriate fish stock management, such as a combination of professional and recreational fishing, can be a model for eco-development. However, local people perceive the area as unattractive to anglers. Lack of joint actions of many partners and the fisheries sector to change this image is part of the problem.

Fisheries in the FLAG Lappi Area

Fisheries Local Action Group (FLAG) Lappi (Lapland) is a part of the Local Action Group Pohjoisin Lappi. This is the northernmost FLAG in the European Union, with almost the entire FLAG area located north of the Arctic Circle. This means that in the summer the sun does not set in two months, and in the winter the Polar Night lasts six weeks. The area of the FLAG consists of four municipalities. Total area is 35 579 km², which is 16 % bigger than the state of Belgium. There are 27 400 inhabitants, the average population density being 0,77 individuals/km².

The total lake area is 3 660 km², and there are thousands of kilometres of rivers and brooks. Around 55 % of the lake area is especially suitable for ecologically, economically and socially sustainable commercial fishing. Most of that area is owned by the state, which means that there are no problems in getting permissions for commercial fishing.

There is no commercial fishing in rivers. Instead, at least half of the households fish for their own consumption and pleasure in rivers and lakes.

The biggest lake is Lake Inari (1 050 km²), situated in the northernmost part of the area. There are 15 full-time and 20 part-time professionals fishing on the lake. The most important species is whitefish, which comprises over 80 % of the incomes of the fishermen, the rest coming from brown trout, Arctic char, perch, pike and vendace. Whitefish is caught with trap nets in summer and gill nets in autumn and winter.

The outlet of the drainage basin of Lake Inari, River Paatsjoki, runs via Norway and Russia to the Arctic Ocean. The fish fauna of the water system is dominated by Salmonid fish. Whitefish, brown trout, Arctic char and grayling are typical species. Vendace was introduced to Lake Inari in the 1960's. Also pike, perch, burbot, minnow and sticklebacks are found. Salmon has never ascended to the area because of the high rapids in the lower part of River Paatsjoki.

The waters in the southern parts of the FLAG area belong to River Kemijoki and River Kemijoki water systems that run to the Baltic Sea. Salmonid fish except Arctic char are found also here, but they do not dominate. The most common species are pike, perch, pikeperch, burbot, vendace and smelt. Also cyprinid species roach, bream and ide are common. The Baltic salmon ascends to River Tornionjoki, but not to River Kemijoki because of dams made for hydroelectric purposes.

Lake Inari is regulated by Norwegian and Russian hydroelectric plants in the River Paatsjoki. To compensate for the damages caused to fish stock by regulation, whitefish, brown trout and Arctic char are annually stocked to the lake. The value of these stockings is 700 000 EUR/year. Nowadays it is forbidden to introduce any new fish species to the lake.
Despite the regulation, the water quality of Lake Inari is excellent, with no signs of eutrophication. In fact, it is classified as oligotrophic.

Every year around 2 000 tourist anglers visit Lake Inari. The lake is so huge that there is a lot of room for sport fishermen, commercial fishermen and the locals fishing with nets for their own consumption. There are no conflicts between different groups of fishermen.

Around 100 km south of Lake Inari there are two large artificial lakes, Lokka and Porttipahta, having a total surface area of ca. 650 km². On those lakes there are 20 full-time and 10 part-time fishermen. The main species are perch, pike, whitefish and burbot. Perch is caught in summer with fish traps made of metal netting. Fyke nets are used to catch pike in summer and burbot in winter, under ice. Trap nets are used to catch whitefish in summer, gill nets in autumn and in winter.

Lokka reservoir at midnight, July 2019

These water bodies are heavily regulated for hydroelectric purposes. The fishermen must adapt their fishing methods to changing conditions.

The water quality of these reservoirs was quite bad in the first decades after they were constructed in the 1960's. Nowadays, however, the quality has improved, which is indicated by good whitefish stocks.

After the construction of the reservoirs, the Siberian whitefish (Coregonus peled) was introduced. After some time, it started to reproduce, and the stockings ceased. Now, only some brown trout are stocked annually.

Reservoirs Lokka and Porttipahta are not popular sites for anglers. Only some local sport fishermen visit them, even though there are good stocks of pike and perch, and also brown trout are caught more and more. Reservoirs are difficult for navigation because of the water level changes, which might be one reason that keeps the tourists away.

In the southernmost part of the FLAG area there are two large lakes, Kemijärvi and Miekojärvi. There are three full-time and approximately ten part-time fishermen. Main species are pike-perch, pike and vendace, which is caught with seines both in open water season and under the ice in winter. Also these lakes are regulated, but there are no problems with water quality.

Trolling for pike perch is quite popular on Lake Miekojärvi. However, there are no conflicts between commercial and sport fishermen. As a matter of fact, during July-August when the catches of pikeperch

in trolling can be 30-50 kg in one night, the sport fishermen sell most of their catch to commercial fishermen with low price. The same phenomenon is found on Lake Kemijärvi for pike.

River Kemijoki has been the most important spawning river for the Baltic salmon, but the dams built for hydroelectric plants right after World War II prevented the migration of salmon, trout, whitefish and lamprey. During the last year there has been a strong debate about building fish passes to enable the migration of fish. However, the dams are not situated in the FLAG's area, and they would not benefit commercial fishing. Consequently, FLAG Lapland has not played an active role in the debate.

In the entire area, the total catch of commercial fishing is ca. 230 -300 tons/year.

The marketed fish must be handled in facilities that meet the demands of the food legislation and have the approval of food authorities. In Finland, these facilities are owned and maintained by the municipalities. Commercial fishermen can use the facilities by paying rent, which is 300-400 EUR/year. Municipalities can get 60-80 % funding from EMFF when they invest in developing the facilities. In the Lapland FLAG area, we have six approved facilities, which is enough to enable commercial fishing in all main fishing areas.

In municipal owned facilities, fishermen may clean the fish and also make fillets. Making processed products like smoked or canned fish is not allowed. Fishermen try to sell most of the fish as fillets to get added value for the fish.

Fishing harbour and a fish handling facility in Lokka

Most of the fish is 'exported' to Central and Southern Finland. Some fishermen are specialized to sell fish for Lappish restaurants. It is not easy to sell directly to local consumers, as in Lapland many families fish for their own consumption.

The reputation of Lappish fish is good, and the demand for our fish in the market is bigger than fishermen can produce. Consequently, the price fishermen get for the fish is quite good.

All fishermen are entrepreneurs. Some are organized as cooperatives, but also those that have no formal corporations cooperate in logistics and marketing. Almost all fishermen buy services from accountant companies for bookkeeping.

For those fishermen that have no other occupation than fishing, the yearly sales are normally between 40 000 to 60 000 EUR. For those who also work, for example, as reindeer herders or in tourism during the winter, the incomes from fishing are, naturally, smaller.
Even though the prerequisites for profitable fishing are good, the aging of the trade is a problem. For some reason, young people do not find fishing an attractive career. FLAG Lapland, together with fishermen, has tried to solve this problem with projects where experienced fishermen give guidance and share their knowledge with young people that are interested in becoming commercial fishermen. For example, in Lake Lokka six young fishermen have started during the last two years. This has given a new drive for the whole trade in Lapland.

ECOLOGICAL FISHING METHODS

Due to their nutrition value, fish have always been a precious source of nourishment. Despite dynamic development of aquaculture in Europe and in other parts of the world sustainable freshwater fisheries are an important source of supply of quality food.

Fisheries along with hunting and gathering has been since the earliest time a way of food procurement. For communities living by more significant water bodies, it has been a main activity and basis of livelihood. The most ancient archaeological troves, which prove that humans fished, date back to the late phase of the Palaeolithic era, some 10,000 years B.C. Fishing was much easier and safer than hunting for obtaining animal protein. Initially fish were hunted with use of spear and harpoon made of antlers or bones. This method worked only in shallow and clear water. In other conditions this type of gear was unreliable, therefore there was a need for improved techniques. In the Neolithic era (6 000 – 2 000 years B.C.) first woven fishing gear were in use, made of longshore plants, plant fibre and hair. Also hooks were introduced. There are many detailed descriptions from medieval times of fishing gear like nets, trap nets, fishing lines or fyke nets. Contemporary fishing techniques are similar to those used by fishermen in the past. Many present fishing tools differ from ancient ones only by size, material and name. Until World War I nets were knitted of flax, hemp and cotton fibre. Wicker was widely used to make hoops of fyke nets. Buoys were made of pine, poplar bark or cork. As late as in the 60-ties of last century, artificial fiber nets came into use since they were long-lasting, less heavy, easier in use and more efficient. Neither they required everyday drying or conservation (Adamczewski J.). In Finland, netting used in trap nets and fyke nets is nowadays made of polyethene, which has outstanding qualities for this purpose.

Fishing Gear Types and Ways of Use

Over centuries of development of fisheries, fishing gears have diversified a lot. Presently they are categorised as follows (Nedelec 1982):
· purse seines
· seine nets (beach seine, single boat seine , double boat seine, under-ice seine)
· dragged gears (bottom, pelagic)
· dredges (boat dredge, manual dredge)
· lift gear (portable lift net, boat lift net, beach lift net, other)
· lantern nets (throw net, other)
· gill and entangling gear (gill nets, drift nets, fixed gillnets - on stakes, trammel nets, gill-trammel nets, other)
· trap gear (open traps, closed traps without wings, closed traps with wings, landing-, push- and stow nets, fish-weirs, aerial traps, traps-hiding places)
· hook gears (whiffing lines, mechanical lines, standing lines, drifting lines, trolling lines, floating lines)
· thrust gear (harpoons, leisters, tridents, grapnels)
· fishing devices (fishing pumps, mechanical drags, eel traps)
· various gears (hand nets, lave nets, electric fishing)
· recreation gears (fishing rods)

Trap Gear – Functioning Principle and Types (Dembiński W., 1975)

Trap gears constitute a type of fishing tools characterised by easy access for the fish, and difficult way out. The fish is attracted by its cache-like shaded interior or by a bait. A fish is led into the trap by all kinds of directing walls and special entrances, shaped as a funnel, aperture etc. Trap gears do not overpower caught fish, just limit their movement space.

Trap gears are used not only for catching fish for food, but also catching spawn fish for reproduction purpose and acquiring material for stocking, as well as regulatory fishing of so called eutrophication species, i.e. roach, white bream, common bream. These species, in waters of high trophic level, create overpopulated herds, which intensify the eutrophication process and result in algal blooms and other negative phenomena (i.e. fish diseases, oxygen deficits).

Fishing with use of trap gear enables full control over fish extracted from the ecosystem. For instance, in ageing barrage reservoirs, one can do a full selection by taking off cyprinid fish and letting free predatory fish, which are beneficial to the ecosystem. This is possible because caught fish stay alive in the fish trap.

Trap gear are very diversified with regard to their size, shape and material they are made of. All types have three elements: fishing cage, gorge and directing wall. The last element is not present in some types of traps, i.e. drums ('bębenki') or cuboid wire fish traps. Catching fish with trap gears is a result of the fish movement alongside a wall directing to a gorge, then into a fishing cage.
Fishing cage can be a closed one (fyke nets) or an open one (trap nets). A closed fishing cage has all sides shut. Usually, it has a shape of a cone with an entrance for fish located in its base and a top serving as a fish storage space. Open fishing cages are built of vertical walls, usually reaching above water level. Fishing cages can be small or large, even very large like it is in trap nets. They are usually made of few elements.

Gorge (also called a heart) is an element connecting the interior of a trap with external space. Every chamber of fishing cage has it. Walls, gradually directing fish to the interior, are an important element of gorge structure. Funnel-like shape of gorge, with much bigger surface of external opening than the internal one, facilitates swimming into a trap and constricts getting out of it. These two extremely different tasks can be hardly fulfilled by a fishing cage with one chamber and one gorge. Hence the multi-chamber traps were invented. First gorge connecting the interior of the first chamber with external space has a relatively big internal opening, which makes getting into the first chamber easier. Fish can get out of the chamber either through this opening (not easy to find as it is not near any wall) or through a much bigger external opening of the second gorge of the chamber. While choosing the latter one they find, at an end of the second gorge, a relatively small internal opening leading into the interior of a second chamber. After traversing it, they find the retreat very difficult. In open cage trap gear gorges are aperture-shaped, not funnel-like, but the mechanism is the same.

Wings are the third essential element of trap gear structure. They connect with one end to a fishing cage and often reach out quite far with another one. Fish, when they touch the wing's wall, move alongside as they can't get through it towards a fishing cage, where some of them get caught. In this way, wings increase an impact area of trap gear, hence their effectiveness.

An asset of trap fishing gear is that caught fish survives. It makes possible size and species-related selection of caught fish and further transportation of live fish for trade and stocking purposes.

Most common trap gear, used in freshwater fisheries in Poland, include fyke nets (*żak*, *mieroża*), *kozak* and (lake) *przestaw*. Trap gears can be divided into basic and combined ones. The latter ones consist mainly of *żak* and *mieroża*.

Żak is a trap gear with double-chamber fishing chamber shaped usually on five hoops. Both chambers have a gorge. First chamber is preceded by a narrow crown (*koronka*). Second one is ended with a cone-shaped *kutel*, from which, after loosening a string, fish can be taken out. *Żaki* can be single with one wing, double with two wings, or single with two wings. Size of żak is defined by the diameter of the first hoop. During fishing *żaki* are set with the use of bottom poles embedded in the lake.

Mieroża has the same chambers as *żak*. The only difference is lack of a crown. Instead, they have a big annex. It is spread on a bow-shaped handle with a string as a bowstring. Construction of *mieroża* assures better adherence of the trap opening to the lake's bottom as compared with a *żak*. Ease of setting in overgrown parts of lakes is an advantage of a *żak*.

Kozak consists of three or four *żak* or a combination of *żak* and *mieroża*. It may have two or four wings.

In big water bodies, trap gears are being combined into long sets called *przestaw*. Because of the size, *przestaw* resembles to some extend a trap net.

Another fishing gear, which can be located between a trap net and a *przestaw* is a box trap. It consists of a fishing cage (usually with seven hoops), an entryway, a kick (*okólnik*) and a main wall.

Trap nets are widely used in freshwater fisheries in northern Finland. Big quantities of fish of various species are caught with this fishing gear. Trap net was used for the first time in Poland in 1960 on a barrage reservoir in Goczałkowice (Korzynek W.,1965). It was an improved version of Chabarow's trap net (USSR). The gear had two directing wings: one - 250 meter long, another – 400 meter long. The entire net was spread on poles and no buoys were used for upper parts of the net. Four fishermen in two boats were necessary to lift a fishing cage. The trap net was in the lake from March until November – 128 days in total. The catch was nearly 11 tons. No other records on use of similar gear in Poland can be found in literature. Finnish trap nets are made of very long-lasting polyethene fibre. They are set on anchors and buoys. Upper parts are armed with buoys. The structure makes possible setting and maintenance by one fisherman. Taking into account its fishing effectiveness and possibility of one-person servicing, finish trap nets seem to be an interesting solution for fishing on barrage reservoirs and big Polish lakes.

NON-SELECTIVE FISHING GEARS USED IN COMMERCIAL FRESHWATER FISHERIES IN NORTHERN FINLAND

Advantages of Non-Selective Fishing

In commercial freshwater fisheries, there are two kinds of fishing methods regarding their impact on fish stocks: selective and non-selective methods. It is widely accepted that selective fishing, most often gill net fishing targeted to big predatory species, has a negative impact on the fish community and the outright lake ecosystem. Therefore, fisheries scientists in Finland recommend that non-selective gears should be favoured in commercial fishing.

Non-selective gears have one important feature that distinguishes them from net fishing: in net fishing, the fish are entangled in the net and often die or get injured, whereas in non-selective gears the fish are gathered in a fish-box, in which they can swim freely. This means that fish that are too small in size or protected by legislation can be released uninjured. Also, the quality of the fish remains good, which is crucial for a commercial fisherman.

According to Finnish experiences, non-selective gears are the best method not only in commercial fisheries, but also in bio-manipulation projects, that aim at rehabilitating water ecosystems by removing small plankton feeders or other detrimental fish.

Non-Selective Gear Used in Northern Finland

Trap-net (pound-net)

Trap-net (scheme: Fig 1) is used to catch mainly whitefish (Coregonus laveretus s.l.) and vendace (C. albula), but it is an all-purpose gear that catches a large variety of fish. In Northern Finland, the majority of whitefish catch is caught with trap-nets. On the lakes where roach (Rutilus rutilus) occurs, trap-net has also proved to be an efficient gear for that species.
The height of the gear and the mesh sizes vary according to the depth of the fishing place and the target fish.
Using trap-nets requires boats that are big enough (5-7 m long, 20-40 hp engine), and skilled fishermen. Basic skills can be obtained in 3-5-day training.

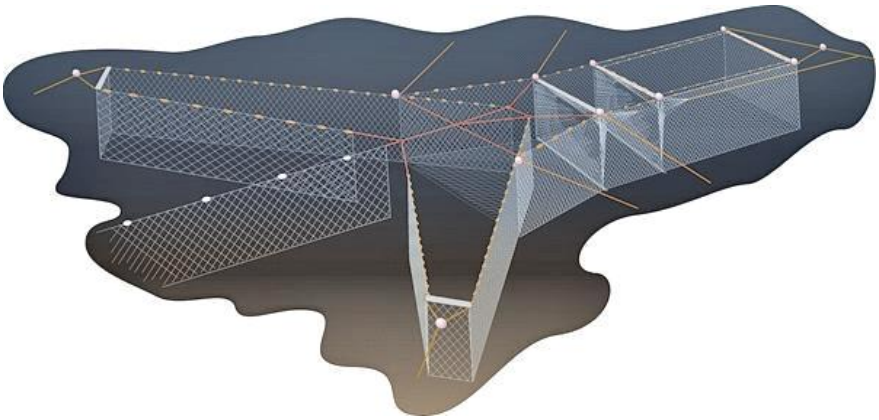


Figure 1. A scheme of a trap-net (pound-net).

When hauling the trap net, the boat is first placed under the gear at the point where the fish-cage begins

The fish box is emptied with a net bag. Fish are placed in tubs, not on the deck of the boat, and some crushed ice is added to cool the fish.

Fyke-net

In Northern Finland, fyke-net is used to catch mainly pike (Esox Lucius) and burbot (Lota lota). In Southern Finland, it is an efficient gear also for pike-perch (Sander lucioperca) and many cyprinid fishes, like bream (Abramis brama). In Lapland, almost the entire commercial pike and burbot catch is caught with fyke-nets.

Fyke-nets are quite easy to use but, of course, in setting and checking the gear in a proper way some know-how is needed.

For the schematic structure of fyke-net, see Fig. 2.

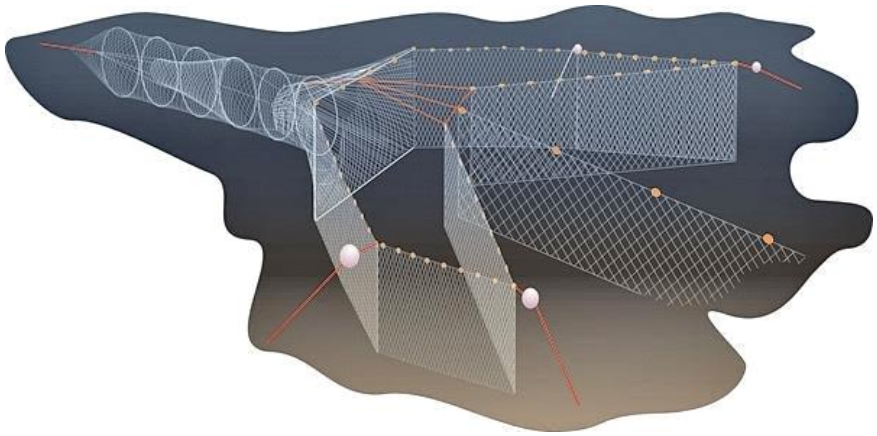


Figure 2. A scheme of a fyke net.

Fyke net is a simple and small, but efficient gear when used properly. It is also quite cost-efficient.

Small fyke nets are easy to handle, and can be operated also by one fisherman.

Fish-trap

Fish-traps (Fig. 3) are made of metal wire net. They are small, ca. 1,3 m x 0,8 x 0,4 m, and technically very easy to operate. However, their effective use requires a lot of knowledge about the behaviour of the fish: which depth they prefer in different temperatures, what kind of bottom, etc. In Finland, fish-traps are used especially for perch (Perca fluviatilis), but they also catch other benthic fish. Almost the entire commercial perch catch in Northern Finland is caught with fish-traps.

Figure 3. A fish-trap.

FLAG has had a project with Sami Education Institute, in which six educational films about the fishing and fish handling techniques that our professional fishermen use have been made. The film showing trap-net fishing for whitefish on Lake Inari can be found here:
https://www.youtube.com/watch?v=iGPvkpvBlcw&feature=youtu.be

17-minute long film shows the structure and operation of a trap-net. In Northern Finland, these kinds of trap-nets are mainly used to catch whitefish and vendace. Trap-net is also effective for catching cyprinid fish like roach and bream.
Although, until present the film has a Finnish language version only, it is worth watching, as it presents very well a structure of a fyke-net and fishing techniques involving its use. The narration has an auxiliary role.

The film was shot on Lake Inari, which is a large (1 080 km2) and deep subarctic lake, the average depth being 14 meters. The effective fishing height of the trap-net in film is 10 meters. In shallower water bodies, trap-nets that high are not needed. For example, on two big artificial lakes in Lapland the fishermen use trap-nets three meter high.

Another video shows fyke-net fishing for (mainly) pike and fish trap fishing for perch on Lokka reservoir. As can be seen in the video, fyke net is also effective for cyprinids, but only handling of pike in the boat is shown, as it has bigger economic importance here than roach:
https://www.youtube.com/watch?v=vJL2UlpMAPM&feature=youtu.be


Fish trap is a light and simple gear that is easily set and hauled by one fisherman. It can be emptied in a few seconds through a lid. The lid must be carefully closed before setting the fish trap again.

There are also films showing net fishing for whitefish in open-water season and in winter on Lake Inari, fyke-net fishing for burbot in winter and handling the fish properly in Lokka.

PARTNERS IN THE "FISHING INTELLIGENTLY – FIN" PROJECT

Local Action Group Zalew Zegrzyński

History of the partnership dates back to 2006, when three entities established the Local Action Group (LAG) Partnerstwo Zalewu Zegrzyńskiego (Partnership of Lake Zegrzyński). These entities were the Social Committee of Support to the Town and Municipality of Serock, the Association "Youth for Development – EMKA" from Wieliszew and the Association for Local Development in the Nieporęt municipality. Activities carried out by the LAG attracted attention of neighbouring municipalities: Jabłonna, Dąbrówka, Radzymin and Somianka, which in a result joined the partnership.
Members of the LAG defined its mission as: "*Initiating and supporting activities of the Partnership area community for preservation of its natural resources and development of its economy, tourism, sports and recreation with a use of the Partnership area historic heritage and culture".*

The LAG's initiatives also included an establishment in 2010 of the Fisheries Local Action Group Zalew Zegrzyński, covering the same area as the LAG. In September 2015 both Groups practically merged under the name of Local Action Group Zalew Zegrzyński. It implements *The Strategy of Community-Led Local Development for 2016-2023 period* for area of municipalities of Dąbrówka, Jabłonna, Nieporęt, Serock, Somianka, Radzymin and Wieliszew, using the European Union and (European Agricultural Fund for Rural Development and European Maritime and Fisheries Fund) and national funds.

Area of LAG Zalew Zegrzyński

LAG Zalew Zegrzyński activities cover an area located between Bug, Narew and Vistula rivers, bordering Warsaw, and most of it, belonging to its metropolitan area. The LAG area features a lowland landscape, marked by river valleys and moraine and kame hills. The share of water in this area amounts to 8%, which is unique in the region of Mazovia. It is due to the fact that the LAG area is crisscrossed by three of four Polish rivers – the above-mentioned Vistula, Narew and Bug. Waters of the two latter were dammed in 1964 to create the Lake Zegrzyński. Other elements of the hydrographic grid include the Żerański Canal, connecting navigation routes of the Vistula and the Narew, canals Bródnowski, Wieliszewski and Komornicki, as well as some smaller rivers and reservoirs.

Another distinctive feature of the LAG area is, high by Mazovia region's standards, index of forestation, which is almost 25%. Natural and landscape value of the area is proved by the fact that as much as 57 % has some form of legal protection. These forms include the Warsaw Area of Protected Landscape, 9 Nature 2000 areas, 10 nature reserves and 173 nature monuments.

Neighbourhood of agglomeration of Warsaw and natural attractiveness of the area result in a very intensive process of settlement. Only in 2010 – 2014 the population of the area increased by 8,000 – some 9%! All municipalities of the area, except the most peripheral and agricultural Somianka, increased their population. For comparison in the same period, the population of rural areas of Mazovia grew by 1%.

The area as a whole, has a recreational function for inhabitants of this most populous Poland's agglomeration. Obviously, the area's tourist businesses' clients come from the entire Poland, Europe and even the world. The number of overnight stays in the LAG Zalew Zegrzyński area per year reaches some 300.000.

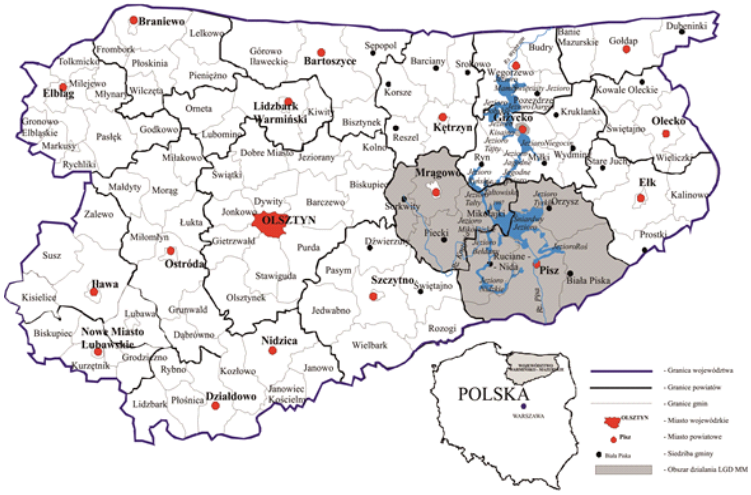
Over ten years of its activities FLAG Zalew Zegrzyński has acquired some 27 million PLN from the European Maritime and Fisheries Fund and national funds, which significantly supported actions of fishermen, business, non-government organisations, public institutions and citizens, aiming at sustainable development of the fisheries sector and Lake Zegrzyński area. A total of 140 projects were implemented. The topics addressed issues like development of fisheries including recreational one (angling), direct sale of fisheries products, raising of citizens' awareness regarding protection of the area's natural environment as a precondition for development of fisheries, tourism and quality of life, rational use of Lake Zegrzyński for the area's economic development, in particular tourism and recreation.

Local Action Group ”Mazurskie Morze”

Local Action Group ”Mazurskie Morze” (Masurian Sea) was established in 2008 as a result of the initiative of six local governments of municipalities surrounding Lake Śniardwy them being Biała Piska, Mikołajki, Orzysz, Piecki, Pisz and Ruciane-Nida. In 2014 municipalities Sorkwity and Mrągowo joined the partnership. In the end, the partnership covers a coherent area of the southern part of Mazury region with similar historical and socio-economic background.

The mission of the Local Action Group “Mazurskie Morze” is as follows: **“***LAG Mazurskie Morze acts for improvement of quality of life of village and town dwellers including those in fisheries-dependent areas by supporting their economic, social and cultural activeness”.*

Presently, LAG “Mazurskie Morze” implements *Local Development Strategy for 2014-2020 period* with the use of the European Agricultural Fund for Rural Development, the European Maritime and Fisheries Fund and national funds. The FLAG, over 10 years of its functioning, provided support to 75 projects with a total value of 6,763,000 PLN.



Area of LAG “Mazurskie Morze”

The LAG area belongs to north-eastern part of Poland (Warmińsko-Mazurskie administrative region) and covers parts of geographic regions of the Mazurskie Lake District, the Mazurska Plain, the Mrągowo Lake District and the Ełk Lake District. It is an area of exceptional abundance of lakes. According to the Institute of Inland Fisheries data it boasts over 300 lakes with a total surface of over 27,000 hectares including the biggest Polish lake – Śniardwy. There are also some rivers flowing through the LAG “Mazurskie Morze'' area with Pisa, Krutynia, Orzysza and Dajna being the most important ones. The LAG area’s surface is quite diversified and at the same time quite coherent landscape-wise, as it was shaped by the last glaciation period some 10,000 years ago. All geological forms typical for the glaciation can be found here and they include moraine hills, outwash plains, ribbon lakes, etc.

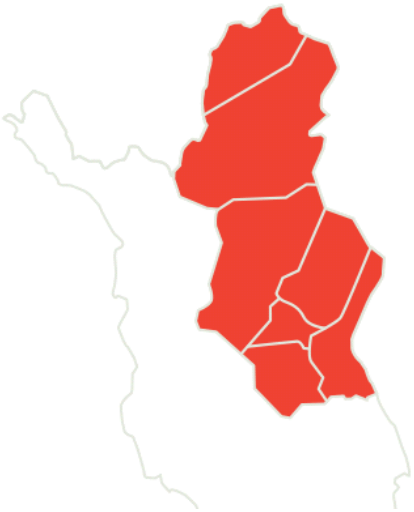
All LAG area municipalities are characterized by a high percentage of forests and water on their surface. There also have a number of protected nature areas with, established in 1970, the Mazurski Landscape Park, which has a surface of 53,655 hectares including over 18,000 hectares of water. There are also sixteen nature reserves and some Nature 2000 areas. Forests, meadows and lakes offer ideal conditions for various species of animals including some 300 species of birds. One can meet here with e.g. a mute swan (Lake Łuknajno is the biggest refuge of this species in Europe), a beaver, a wild pony (*konik polski*). One can also see such rare bird species like grey heron, cormorant, crane, grouse, black stork, lesser spotted eagle, eagle owl, golden eagle or white-tailed eagle.

Diversified landscape and nature provide very good conditions for various forms of active tourism i.e. walking, biking, kayaking, sailing, horseback riding, skiing, paragliding and other. It is no surprise that the business activities of the local population focus on tourism. Recreational visits of the area became popular at the end of XIX century, when in 1891 steamboats cruises were initiated on the Great Masurian Lakes. Since then the region of Mazury has been gaining its reputation as a tourist destination. Today foreign tourists, mainly from Germany, are an important group and more of Poland's eastern neighbours arrive. A total number of visitors varies between 400,000 and 500,000 annually and grows gradually.

Local Action Group Leader Pohjoisin Lappi ry

Local Action Group Leader Pohjoisin Lappi ry has been active since 1996, animating citizens, communities and businesses for development of its area. Since 1997 the association has been acquiring funds of various European Union programs to be used for increasing the activeness of inhabitants and attractiveness of the area.

Leader Pohjoisin Lappi ry is the northernmost Local Action Group in Europe. Although it covers with its activities only six municipalities, Utsjoki, Inari, Sodankylä, Pelkosenniemi, Savukoski, Salla and Kemijärvi, it is surface-wise one of the biggest, if not the biggest, LAG in Europe.



The LAG area boasts an unspoiled nature of the Finnish Lapland - calm, charming, vast national parks and wild rivers. The region offers clean raw materials for natural products processing, wood processing, conditions for reindeer and cattle breeding, possibilities for development of fisheries, as well as options for clean energy production.

The LAG area boasts renowned, not only in Finland, tourist resorts such as Saariselkä, Pyhä-Luosto, Sallatunturi and Suomu. Many small tourist businesses are active here. Wild nature, clean environment, traditional livelihoods and some 90 authentic Lappish villages make the area a good environment for this sector. Authenticity of culture is particularly visible in northern municipalities. The region has a long border with Norway and Russia, which provides additional opportunities for development.

LAG Leader Pohjoisin Lappi ry aims at the region's development based on the LEADER principle of its bottom-up nature. LAG's task is to encourage inhabitants of rural areas to develop their region in order to make it more dynamic and attractive and to create new businesses and jobs. The bottom-up

approach is crucial in projects in which development activities are planned and carried out by inhabitants of the region. Promotion of innovativeness and community spirit are other vital features. With this respect the LAG carries out following activities:
· animates and provides advice to local entities
· assists in preparation and implementation of projects, including provision of co-financing
· facilitates contacts with authorities
· carries out its own strategic projects: development of youth animators network, preservation of cultural landscape and development of rural tourism, support for business establishment and development
· informs the local community and other stakeholders about its activities and results.

The LAG gets involved in long-term cooperation with the region's settlements to increase their vitality. The Group has an extensive experience in implementation of cooperation projects concerning development of rural tourism, establishment of village activity centres, culture in tourism, as well as development of natural products. It also gets involved in cooperation with businesses, local governments and other entities dealing with the growth of the region. It has a particular experience in development of peripheral areas, as well as in development of rural areas' potential for use of IT and technology in vast areas.

All activities must be in line with elaborated by the LAG strategy for 2014-2020 period, called "Fearless North", which aims at creation of conditions for living in the North. Funds for implementation of the strategy support i.a. entrepreneurship, quality of rural life, increasing attractiveness of rural life for the youth, as well as Sami culture. Activities within implementation of the "Fearless North" strategy are meant to foster enthusiasm and courage for the sake of the region's development, increase competence of citizens and entities and encourage their cooperation. The leading motive is using local knowledge and know-how for the development of the region.

Fisheries Local Action group Lapland has been a part of LAG Leader Pohjoisin Lappi since 2008.

BIBLIOGRAPHY

1. Adamczewski J., Historia i tradycje rybactwa, www.wigry.org.pl
2. Dembiński W., 1975, Pułapkowe narzędzia połowu ryb rodzaje narzędzi pułapkowych. Broszura Instytutu Rybactwa Śródlądowego.
3. Korzynek W., 1965, Niewód stawny nowe narzędzie połowu ryb. Broszura Instytutu Rybactwa Śródlądowego
4. Nedelec C., 1982, Definition and classification of fishing gear categories. FAO Fish. Tech.Pap.
5. Ahonen M., 2019, Non-selective fishing gears used in commercial freshwater fisheries in Northern Finland
6. Lokalna Strategia Rozwoju LGD „Mazurskie Morze" na lata 2014-2020
7. Strategia Rozwoju Lokalnego Kierowanego przez Społeczność na lata 2014-2020 dla obszaru gmin: Dąbrówka, Jabłonna, Nieporęt, Radzymin, Serock, Somianka, Wieliszew
8. „Peloton Pohjoisin" – lokalna strategia rozwoju LGD Leader Pohjoisin Lappi ry