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The emergence of the co-expertise process in the ETHOS project in Belarus after the Chornobyl accident

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Abstract

The origin of the ETHOS Project arose in the early 1990s from the observation that populations residing in the areas contaminated by the Chornobyl accident had largely lost control of their daily lives. Led by a multidisciplinary team of French experts, the project started in July 1996 in the village of Olmany, and was extended later in 4 other villages of the Stolyn District in the South of Belarus, about 250 km West from Chornobyl. Based on the direct involvement of the population from the affected areas in the improvement of their protection and their living conditions, the project has seen the emergence of the co-expertise process now recommended by the International Commission on Radiological Protection (ICRP) in the management of post-nuclear accident situations. This article first presents the context of the ETHOS project's deployment, then the fundamental principles that guided its implementation over five years. It then describes its application by working groups composed of villagers and members of the ETHOS team, as well as the international seminar held in Stolyn which concluded the project.

Introduction

The history of the ETHOS project began in the early 1990s within the framework of the cooperation agreement between the European Economic Community and Russia, Belarus, and Ukraine: the so-called EC-CIS project (European Union, 2025). This project aimed to study the nature of the radioactive contamination resulting from the Chornobyl accident, to develop the technical skills necessary to manage such accidents in the future, and to improve emergency management

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DOI: 10.1051/978-2-7598-3968-1.c001

procedures. It was during this five-year research program (1992-1996) that the idea of giving the populations of the affected territories back control of the situation emerged. Indeed, the researchers involved observed that the post-accident crisis persisted and affected all aspects of society. By studying the psychological and social consequences among the cleanup workers, those relocated, those living in contaminated areas and the general population, this work led to a rethinking of the role of experts and authorities. In fact, the authorities were confronted with a lack of trust among the general population and were unable to improve the radiological situation of the inhabitants, who were facing a serious economic crisis. In this context, the regulation and technical measures imposed by the authorities and experts were ineffective in ensuring that the people living in contaminated areas were adequately protected. Rather than deciding on, and implementing regulations and technical measures, in the hope of solving people's problems, the idea that experts should cooperate with people to make sense of the situation and help them regain control, gained traction. It was at the international conference, jointly organized by the European Commission and the Ministries of Health of Belarus, Russia, and Ukraine, held in Minsk in April 1996 and entitled "The Radiological Consequences of the Chernobyl Accident", that the psychological and social results of the research were presented (European Commission, 1996). At this time, a discussion with the Minister of Chernobyl of Belarus (the most affected Republic) led to the suggestion of developing a pilot project to explore how to directly involve the population of the affected areas in the improvement of their protection and their living conditions.

With the support of the European Commission and the close cooperation of the Belarus Chernobyl Committee, the ETHOS project started in July 1996 first in the village of Olmany, then in 4 other villages of the Stolyn District in the South of Belarus, about 250 km East from Chornobyl (Hériard-Dubreuil et al., 1999) It was implemented by a multidisciplinary team of 12 French experts in radiological protection, agronomy, local development, sociology, psychology and philosophy.

The first section describes the very specific strategic context in which the project was deployed. The second section presents the project's key principles. The third section presents the implementation of the local projects developed by working groups including villagers and the members of the ETHOS team, and the fourth section presents the extension of the project until 2001 and the Stolyn International seminar which concluded the ETHOS project.

1. The strategic context of the ETHOS project

In the weeks and months following the accident, the Soviet authorities initially managed the situation based solely on radiological exposure criteria and standards. The contaminated areas were vast, roughly a quarter the size of France affecting the three Republics — Belarus, Russia and Ukraine. In Belarus, the most affected republic, nearly 20% of the territory was contaminated. The authorities evaluated that, in roughly 80% of the affected territory, the level of contamination resulted in an average annual dose for the population of less than 5 mSv. In the late 1980s, this value corresponded to the annual individual dose limit recommended by the International Commission on Radiological Protection for members of the public for normal situations. The prevailing view was therefore that below 5 mSv/year, territories could be excluded from post-accident management, and that intervention was only necessary above that criterion. This approach was adopted to limit the scale of the problem and to address both economic and political concerns. However, as early as 1990, the international community adopted the new individual dose limit of 1 mSv per year for members of the public for normal situations. This provoked the population affected by the Chornobyl accident to strongly reject the standard imposed by the authorities. This reaction combined with a period of disturbances linked to the collapse of USSR, gave rise to similar demands by political movements during the first elections following the independence of the three Republics. Finally the value of 5 mSv per year was rejected in the 3 Republics and the value of 1 mSv per year became the basis for all post-accident legislation after 1991.

Despite all the measures adopted by the authorities, the presence of radioactivity remained a constant source of concern for the population. This phenomenon was termed "radiophobia", by the authorities, a concept introduced very soon after the accident to describe the anxiety of people affected by radioactivity. This terminology was also widely adopted by the international community of radiation protection professionals. Faced with this situation, the logical solution was to implement a program of "psychological rehabilitation' through the deployment of psychotherapeutic resources. UNESCO thus embarked on a strategy of establishing "psychological rehabilitation centres" to try to bring anxious and worried individuals back to a more peaceful state of mind. Field interviews conducted as part of the EC-CIS project with people supposedly suffering from radiophobia, revealed that they were just subject to fears, quite rational fears for people experiencing a loss of social confidence. There was a widespread fear of an invisible, omnipresent object, impossible to grasp except through fairly coherent technical means, impossible to assess without some background in radiation protection. After the accident, there was a general loss of confidence in the authorities, in the experts and in science. People were left alone confronted with a situation very difficult to understand. Their priority was their safety. Addressing the problem from a purely psychological perspective was completely inappropriate for their expectations. The psychotherapeutic approach, therefore, failed to address the problem and was gradually abandoned in favour of a more communication-focused approach.

The authorities eventually concluded that the root of the problem laid in the lack of information, and that by increasing the dissemination of information on protective measures, it would be sufficient to resolve the recurring concerns. Here too, this approach proved to be a dead end. First, because the dissemination of information is ineffective in the context of lost trust. Moreover, risk perception is a psychological trait that is unique to each person. Consider the example of people who had left certain areas and decided to return, knowing that the very act of living in those areas entailed risk. Fundamentally, the decision surrounding risk-taking involves the mobilization of the person taking the risk. It is not simply a matter of information.

Ultimately, the post-accident management of Chornobyl clearly demonstrated the limitations of a risk management approach focused solely on reducing risk and providing recommendations on radiation protection. This is primarily because the economic and social context clearly played a crucial role in the deterioration of living conditions for the affected populations. In the initial years following the accident, the strategies developed by the authorities enjoyed a period of relative success: evacuation of the most contaminated areas, implementation of various countermeasures in agriculture, cessation of private food production, and supplying stores with clean food.

Finally, despite all the above attempts to manage the situation, the ongoing concerns of people living in affected areas were not significantly addressed. Even though exposure levels were relatively low across a large part of Belarus a decade after the accident due to radioactive decay, the population still had to confront the persistent residual levels of radiation. The later also constituted a major obstacle to the long-term preservation of socio-economic infrastructure and the quality of life of the inhabitants.

It is within this context that the ETHOS project was launched in the village of Olmany in the Stolyn district (Figure 1), with the aim of actively and sustainably involving the villagers in their protection and in the overall rehabilitation of their living conditions. This was done thanks to the support from the European Commission and Belarussian authorities.

FIGURE 1. Olmany in the Stolyn district of Belarus (from Google Maps with the authors having made some additions).

1.1. *The ETHOS project: a new approach to recovery*

The ETHOS approach in Belarus provided a change in direction from the previous post-accident management strategies (Hériard-Dubreuil et al., 2004). This approach not only considered risk reduction but also rehabilitation of living conditions. Furthermore, the population became actively involved in their own risk management. The term "rehabilitation of living conditions" was adopted to avoid the ambiguity that often arises in this type of situation, where the rehabilitation of territories is discussed as if it were possible to eliminate contamination. It cannot be eliminated and in the post-accident context, it is much more about rebuilding ways of life that allow populations to live safely in these areas. It was primarily a matter of a profound reorganization of lifestyles — economic, cultural, and social — in order to restore decent living conditions. This original approach thus simultaneously considered technical and social aspects. The idea was not to adopt a technical approach first and then focus on social issues. The decision was made to bring together different areas of expertise within a single team to avoid the lack of coordination often observed. The team therefore combined solid expertise in radiation protection, social risk management, agronomy, and more specifically in biodiversity management and heritage strategy, as cultural heritage had been profoundly affected by the post-accident crisis. In addition to this expertise, there was also expertise in building trust in the context of technological risks.

Talks with the Belarusian authorities had shown that they were approaching the issues rigorously, as they represented a political imperative for them: the inhabitants of the contaminated territories comprised 0.03% of the Russian population, approximately 4% of the Ukrainian population, and 20% of the Belarusian population. It was therefore a priority issue of national importance for the Belarusian authorities, who demonstrated a genuine interest in finding a site to implement the ETHOS project.

A small group of ETHOS team members visited all the districts of the contaminated territories in Belarus, where they presented the ETHOS project to the local authorities of various villages interested to cooperate. Ultimately, the village of Olmany, located in the Stolyn district in the southwest of the country, 200 km from Chernobyl, was chosen, in an area legally designated as a "voluntary resettlement zone". The Belarusian legal system divided territories into three main categories. When the average annual radiation dose received by the population was estimated at more than 5 mSv/year — a level considered intolerable — the territories should theoretically be completely evacuated. Between 1 and 5 mSv/year, the Belarusian authorities implemented an original concept regarding the risk of residing in these territories, through laws whose application relies on the voluntary participation of the population. Residents could choose to stay or leave — with partial reimbursement of their expenses — hence the name "voluntary resettlement zones". Below 1 mSv, these are "strict control zones": apart from a few checks, few measures were taken, and the population received only minimal support from the authorities. Figure 2 present a general view of the village surrounded by swamps and forest located at the end of a dead-end road. With a population of 1255 inhabitants including 370 children under 18 years old, the main activity was agriculture with a kolkhoz covering about 1800 ha. But inhabitants derived a significant portion of their incomes from berries picking and mushrooms from the forest. The village had a kindergarten, a primary school and an ambulatory hospital.

FIGURE 2. The characteristics of Olmany in 1996 (photo: J. Lochard).

Upon arriving in Olmany, the ETHOS team did not have the methodological framework presented in this chapter. This framework was built empirically and progressively through trial and error in the field during the ETHOS project. However, the team had clearly defined the contractual and ethical framework of the project from the outset, which aimed to build trust with the village population. How did they proceed? The first step consisted of establishing a basic level of trust between the team and the population by organizing a large public meeting attended by about one hundred villagers. During this meeting, the team was asked a number of questions. One of the anticipated and inevitable questions asked to the team was "can we live here"? It had been decided in advance not to answer this question directly, mainly because the decision to remain in the village belonged to the people directly affected; the area was legally designated as a voluntary resettlement zone. The members of the ETHOS team therefore clarified that they had not come to answer this question, but rather that they were willing to help the people who wished to live in the village and work with them to concretely improve their living conditions over three years. This commitment to come and work for three years to improve the situation constituted a strong ethical stance. To the question, "Would you have chosen to live here?", the team's responses were quite diverse and nuanced, but no member stated that they would actually want to permanently reside in Olmany!

Regarding the question of trust, the members of the ETHOS team quickly understood the importance of being committed for a three-year period and that they had to demonstrate their commitment. During the second mission, the team rented a house on a three-year lease, which they fitted out with offices and a meeting room, and which became the ETHOS house. This initiative definitively dispelled the lingering fears among some residents regarding the team's genuine commitment to working within the village to tangibly improve the situation.

2. The practical implementation of the ETHOS project

The first step of the co-expertise process essentially consisted of assessing and quantifying the radiological situation with the local population. It is important to note that this work was carried out collaboratively with the villagers. Radiation measurements were taken and certified to gradually paint a picture of the radiological situation in the village of Olmany. From this foundation, it was possible to begin a quantification process, moving from a completely unclear and gray picture to a much more nuanced and contrasting one. This sometimes yielded pleasant surprises—for example, some mothers noticed that the inside of their homes was "clean"—and sometimes, conversely, worrying things, such as those related to milk production. The team and the villagers then focused on identifying areas for improvement, taking into account available resources, in order to develop realistic solutions adapted to the situation. When it came to the step of making choices, the co-expertise was again based on dialogue and strong involvement of the villagers. Life in the contaminated areas inevitably involves dilemmas because protection resources are often limited. The villagers preferred, for example, that the available resources were dedicated to child protection. This was a choice no one could make for them. Similarly, choices had to be made between protection and income, between short-term and long-term goals. All these choices were extremely delicate, it was clearly a decision to be taken by the villagers themselves, as they are existential in nature.

The next step for the villagers was therefore to implement these choices with the ETHOS team and, if necessary, with the support of local authorities. Indeed, throughout the ETHOS project, the team maintained constant contact with local, regional, and national authorities. These authorities, moreover, shifted from a kind of benevolent neutrality to progressive involvement as the ETHOS project advanced, opening up new avenues for action and opportunities for intervention.

Six practical local projects were developed within the framework of the ETHOS approach: a project with mothers on children's radiological protection, a project with private farmers to improve milk quality, a project to rebuild the entire economic chain of meat production and marketing, an educational project to work with the Olmany school, a project on the management of contaminated ashes from village hearths, and finally, a video project with the village youth. It took more than a year to put in place the various projects. The process started first with the young mother's and the milk groups. They were then followed by the 4 other groups.

2.1. *The radiological protection of children*

This section outlines the action that gradually developed between the ETHOS team and the mothers of families in the village of Olmany, for the management of the radiological safety of children.

Listening to and talking with the villagers, it quickly became apparent that among those most interested in the presence of the French experts in the village were many mothers, particularly young mothers, deeply worried about their children's health, both in the short and long term.

What was the context of this concern? First, the official discourse of the doctors who regularly visited the school to examine the children and conduct basic tests indicated that their health was slowly deteriorating. Feeling powerless in the face of this situation, they tended to address the families, especially the mothers, during the parent-teacher meetings held after these consultations: "Your children are sick. What are you doing for their health? Stop giving them contaminated food". This situation ultimately generated a heavy sense of guilt among the mothers. They were aware that it was primarily their responsibility to intervene regarding their children's diet and that they were ultimately responsible for their health. And at the same time, they knew perfectly well that protection was very difficult to implement because, within the family, it essentially consisted of multiple prohibitions imposed on the children which, ultimately, prevented them from living as the village children had always done for generations: "Don't go to play in the garden, or in the forest. Don't eat blueberries or mushrooms. Don't swim in the river, it's contaminated"... Moreover, for these families living in very precarious economic circumstances, with a small plot of land where they grew vegetables and raised one or two cows, the room for maneuver was very limited. On the one hand, the produce was contaminated; on the other, village tradition dictated consuming local products. And, given the general economic situation, there wasn't really a choice. They had to give milk to the children. And besides, the children loved it... This situation, therefore, represented a major challenge for the mothers.

Another factor contributing to public concern was that, ten years after the accident, the population still had a complete lack of knowledge about the levels and mechanisms of how they were being exposed, and therefore no frame of reference for taking appropriate action. It is worth noting that the education system in Belarus was very effective. Belarusians are educated, articulate, quick learners, and read newspapers, even in rural areas. However, upon arriving in 1996, the ETHOS team found that the inhabitants had no idea about the levels of exposure and that even the simple distinction between "external exposure" and "internal contamination" was incomprehensible to them. Over the previous ten years, numerous measurements had been taken by the Belarusian authorities or by other scientific teams visiting the village, but no understandable feedback had been provided to the population.

The third important aspect in this context was that the children's health was ensured by the community through the school system. First, uncontaminated food was distributed to all schools in the affected areas. Whenever they were at school, the children were not ingesting radiation. The same was true when they visited sanatoriums. In fact, twice a year, the children spent a month in a sanatorium located in the uncontaminated regions of Belarus. In addition to these stays in Belarus, the school also organized trips abroad. For years, entire classes of children thus left their families during the summer holidays. The responsibility for protecting the children's health therefore fell to the school, which created an uncomfortable paradox for the young mothers: by perpetuating a traditional family lifestyle, they endangered their children, and it was only outside the family setting, when their children were cared for by the public system, that they found relative peace of mind. It is therefore understandable how maternal anxiety could develop in this situation where they felt powerless to act for their children.

Based on these observations, and through discussions with the mothers, the idea of creating a local group focused on child protection emerged. Initially, the ETHOS team tried to explain, from a theoretical perspective, the phenomena of external radiation and internal contamination, as well as the mechanisms by which children could be exposed, but this approach proved unsuccessful. The ETHOS team shifted its focus and, together with about ten mothers from the village, embarked on a measurement program to better understand and pinpoint the ambient contamination, and also to assess the amount of becquerels ingested by the children. In doing so, the team encountered significant challenges in finding user-friendly, robust measuring devices that could be integrated into everyday life. The mothers were then trained on how to use these devices, took measurements together, and to operate the equipment independently. A scaling-up process then began, spearheaded by the mothers, to measure ambient dose rates in homes and gardens. After taking some measurements in the houses, the ETHOS team and the group of mothers quickly realized that the most worrying problem lay in the ashes. In Olmany, traditional wood-burning stoves were used, and since the burned wood was highly contaminated, radioactivity accumulates in the stove fireboxes. Measurements were taken in the gardens where ashes were regularly spread.

Together, experts and mothers developed a protocol stipulating that for each house the ambient dose rate had to be measured in all the rooms, particularly around the stoves, and also in the gardens, to see if there were any significant differences. The first measurements were taken in the home of a young mother (see Figure 3). When the ETHOS team returned to Olmany three months later, it was pleasantly surprised to find 15 house plans. And, in the end, several dozen house plans spread throughout the village were done. The mothers also had the idea of organizing excursions with the school children to take measurements in the surrounding area. They drew their routes on paper, recording the measurements taken, which they then displayed at the school (see Figure 3).

FIGURE 3. Measurements of mothers (photos: J. Lochard).

In total, 298 measurements were taken inside the houses, 67 measurements near or inside wood-burning stoves, and 350 measurements in the gardens. The ETHOS team together with the group of mothers analyzed the data and tried several types of graphical representations. The problem of scale quickly arose: was it highly contaminated, or not at all? A point of comparison was needed. The mothers then asked, “And what about the radiation in your houses in France?” The ETHOS team engaged in a discussion on the issue of natural radiation, explaining that, independently of the Chornobyl contamination, when measuring ambient radioactivity in France, one can find varying levels. Measurements in the homes of ETHOS team members were performed and when back in Olmany, were compared with measurements from Olmany houses. The mothers were able to see that, ultimately, the radiation levels inside the village houses were quite similar to those found in France. This was, incidentally, good news that quickly spread throughout the village. Ultimately, the group chose the average natural radiation exposure in France as the reference level for assessing the situation in Olmany, namely an average ambient dose rate of around 0.15 microSv/h. From this, it was possible to construct a “management scale for external radiation”, allowing the development of precautionary measures to adopt in relation to ambient dose rates. This scale ranged from 0 to 2 microSv/h. Up to 0.2 microSv/h, the mothers considered there was no problem. Dose rates between 0.2 and 1 microSv/h — which were equivalent to a dose of approximately 10 mSv/year — the mothers decided that it was preferable to reduce the length of stay in these areas. Above 1 microSv/h, these were areas to avoid, except in exceptional circumstances. For example, if you had to cross the forest to collect firewood or pick blueberries, encountering dose rates ranging from 1.5 to 2 microSv/h, was not a problem. However, it was advisable to avoid spending entire days in the forest. The ETHOS team discussed the "prohibition" aspect, emphasizing the importance of time management: "If you don't have to go to a contaminated area, why then to go?" This was the philosophy behind the scale, built together between mothers and experts, a philosophy that was satisfying the villagers (Figure 4).

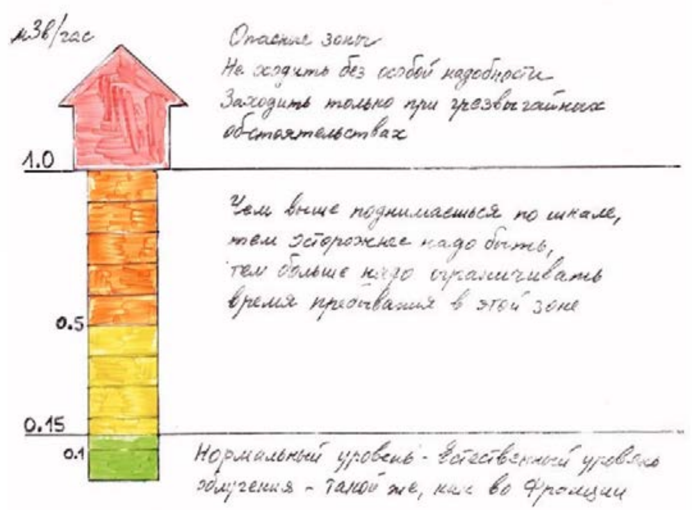


Figure 4. The external dose scale (photo: J. Lochard).

Alongside their work on external radiation, the ETHOS team encouraged the group of mothers to address the issue of internal contamination of children. Once it became clear to the mothers that the problem lay in the radiological quality of food, action had to focus on the diet. The mothers began by meticulously recording in notebooks what their children ate each day. When the first notebooks were analyzed, it became clear that the idea of an average ration, even for a small village in Belarus, was meaningless. Each family had its own eating habits, and within the same family, each child had their own preferences. There were staple foods like milk, potatoes, and berries, but also various other products whose consumption varied greatly from one child to another. The group of mothers then understood that, just as with external irradiation it had been necessary to work house by house. For internal contamination it was necessary to assess food rations child by child and, moreover, to measure the contamination of the different foods included in these rations, since the products themselves varied greatly in terms of contamination depending on their origin.

It should be noted that the Belarusian authorities had, for a number of years, implemented a system for monitoring the radiological quality of food. Thus, in the village of Olmany, a radiometrist regularly took samples of products, measured them, and sent the results to the authorities in Minsk. However, there was no feedback of this information to the villagers. This radiometrist had developed her own expertise in radiology and was quite cautious within her family, but in the absence of place for dialogue, results were not discussed within the community. Initially, the ETHOS team collected all the existing measurements — there were several hundred — and analyzed them together with the group of mothers. Then, the mothers were invited to actively participate in measuring food. The group took charge of collecting vegetables from the gardens and bringing them to the radiometrist. Very quickly, the number of measurements multiplied, and it became necessary to ask the authorities for help in setting up a second measurement station in the village. To eliminate any doubts about the quality of the food products and the performance of the device used by the radiometrist, the ETHOS team performed measurements in France on samples already measured in Olmany. The comparison of the measurements proved very satisfactory.

By compiling all the measurements, it was then possible to create a map of the radiological quality of food products in Olmany. With the mothers, it was decided to adopt a three-tiered approach: "clean" products — essentially all the food that came from the store — products "less susceptible" to contamination — mainly vegetables — and finally products "very susceptible" to contamination such as mushrooms (samples measured in the village vary between 400 and 16,000 Bq/kg of Cesium 137 (Cesium 134 being negligible) for fresh mushrooms and up to a maximum of 70,000 Bq/kg for dried mushrooms, cranberries, blueberries (between 100 and 3,600 Bq/kg), dairy products, and meat. The classification work simultaneously enabled mothers to grasp the meaning of regulatory standards regarding food contamination, and thus contributed to a clearer understanding of the authorities' actions in this area.

The group of villagers then moved on to analyzing the children's food rations. Several mothers compiled a list of all the products their children had eaten in a single day, along with the corresponding quantities. Based on this information, it was possible to calculate the amount of becquerels ingested through these rations, taking into account, for each product, the maximum and minimum contamination levels measured in the village. From these calculations, it immediately became clear that it was possible to take action to improve the radiological quality of the daily rations. The mothers realized that, depending on what they fed their children, the amount of becquerels ingested could vary between 50 and 800 becquerels per day. This presented them with a real opportunity for action. Experts and mothers then worked together to explore ways to manage the children's internal contamination on a daily basis, particularly with regard to the consumption of milk, berries, and mushrooms. Together, they established a new three-level scale: below 50 Bq/day (an annual individual dose of approximately 0.2 mSv), the situation was considered acceptable and the food could be consumed without any restrictions; between 50 and 300 Bq/day (a dose of approximately 1.3 mSv/year), it was necessary to try to reduce the consumption of the most contaminated products as much as possible; above 300 Bq/day, it was necessary, as far as possible, to avoid ingesting these products and to find substitutes (see Table 1).

TABLE 1. The Influence of the level of contamination of food products on the daily intake of children (From J. Lochard, 2013).

		Maximum contamination		**Minimum contamination**	
Foodstuff	**Grams**	**Bq/kg**	**Ingested (Bq)**	**Bq/kg**	**Ingested (Bq)**
Bread	250	60	15	10	2.5
Butter	10	400	4	30	0.3
Vegetable soup	300	100	30	10	3
Meat	200	300	60	10	2
Stewed apples	150	100	15	10	1.5
Sauerkraut	300	50	15	10	3
Potatoes	100	100	10	10	1
Stewed moorberries	200	2 000	400	100	20
Chocolate milk	100	2 000	200	10	1
		Total	**749**	**Total**	**34.3**

Once the mothers felt empowered to influence the level of internal contamination in their children, they asked how they could monitor the effectiveness of their actions. It was at this stage that the reconnection with the public health system and the district administration took place. Indeed, it became clear that, in order to verify the results of the actions undertaken by each mother on food consumption, it was necessary to utilize the whole-body internal contamination measurements carried out at the school. To achieve this, it was essential to engage the relevant doctors in the project. The ETHOS team and the mothers jointly presented the group's findings to the regional authorities. The medical officer for the Stolyn district immediately grasped the value of the approach. He expressed his desire to participate in the project and involve some local doctors. These doctors quickly realized the educational role they could play regarding the issue of internal contamination and the mothers' actions. They also understood that this presented them with an opportunity to take more effective action by relying on the mothers' active participation.

In practical terms, a doctor interested in the project joined the group of mothers and participated in the working meetings. A protocol for monitoring the children of the mothers in the group was established, including an initial in-depth medical examination, followed by regular whole-body internal contamination measurements, and an annual medical check-up. This fostered a dialogue between the doctor and the mothers. The long-term objective, beyond monitoring internal contamination and the children's health, was to disseminate the ETHOS approach beyond the village.

Once the group had individual data on the children's internal contamination, the mothers sought to understand the reasons for the significant differences observed from one family to another, as well as within the same family. Numerous questions arose, particularly concerning the benefits of sanatorium stays. To investigate this point, the ETHOS team developed a simple model to calculate the average daily becquerel intake per child between two whole-body internal contamination measurements. The team studied the case of a schoolgirl who spent 11 days in her village, 30 days in a sanatorium, and the rest of the time with her grandmother in an uncontaminated area. During the 61-day period between the two measurements of total internal body contamination, the model showed that the girl had ingested a total of 2750 becquerels. If, instead of going to the sanatorium, she had stayed in Olmany and ingested clean products, approximately 40 becquerels per day for 61 days, she would have ingested only 2440 becquerels. The calculations therefore showed that sending children to the sanatorium was of little benefit if they could ingest clean products in the village. This observation sparked a debate among mothers and authorities, which remained unresolved until the end of the ETHOS project.

Finally, the mothers involved in the local group worked to disseminate the ETHOS approach to other mothers in the village. At the same time, the doctors developed a strategy to try to replicate the experience gained in the village of Olmany throughout the district.

2.2. *The improvement of the milk quality*

The radioactive contamination of a territory where populations are strongly dependent on rural activities for their livelihoods, immediately raises numerous difficulties in relation to the radiological quality of agricultural products. This imposes a more or less profound re-organisation of the agricultural production system. These difficulties are very complex to resolve because they encompass many different and interrelated aspects affecting daily life: radiological risk, diet, management of private agriculture, recreational habits and family income.

Traditionally in Belarus, milk constitutes an essential part of the diet of the rural population, especially among young babies and children. After the Chornobyl accident, the contamination of pastures with ^{137}Cs led to milk becoming a major source of radiological exposure for the entire population. It was very difficult to guarantee the radiological quality of milk from private farms. Consequently, the authorities attempted to reduce the consumption of contaminated milk from these farms, by requisitioning all privately owned cows, urging families to buy non-contaminated milk in shops. However, the economic crisis following the break-up of the former USSR contributed to reduce family resources even further and they gradually began breeding cows again to meet their basic needs. But the remaining problem of contamination put the families in a vicious circle. On one hand, because of the collapse of the economy they had no money to buy uncontaminated milk in shops and therefore relied on private production to feed the family. On the other hand, many of them could not increase income by trading milk because of its poor radiological quality, which was well above the regulatory radiological standards.

The ETHOS project's approach highlighted a paradoxical situation (Lepicard and Hériard-Dubreuil, 2001). Most scientific knowledge was not truly integrated into practical know-how that could be used daily by the population.

For example, the mechanisms of radiocesium transfer from soil to grass, and then from grass to milk, are theoretically well understood by radioecology experts but were unknown to villagers. Similarly, the role of Ferrocyn as a feed additive to reduce the cesium transfer coefficient from forage to milk was ignored by farmers. This simple and practical information was nevertheless crucial for managing the day-to-day radiological quality of milk production, depending on forage contamination.

As already noted, discussions with the inhabitants of Olmany in summer 1996 revealed that mothers, particularly the younger ones, were extremely anxious about contamination of the milk which could reach up to 2,000 Bq per liter (^{137}Cs) for some families. Initial meetings with mothers and private farmers, who owned at least one cow for milk production, showed that the problem of milk contamination was of primary importance. The population felt deprived of any means to change the situation. As they put it: "Can we do something to improve the radiological quality of milk? Could we at least produce non-contaminated milk for our children?".

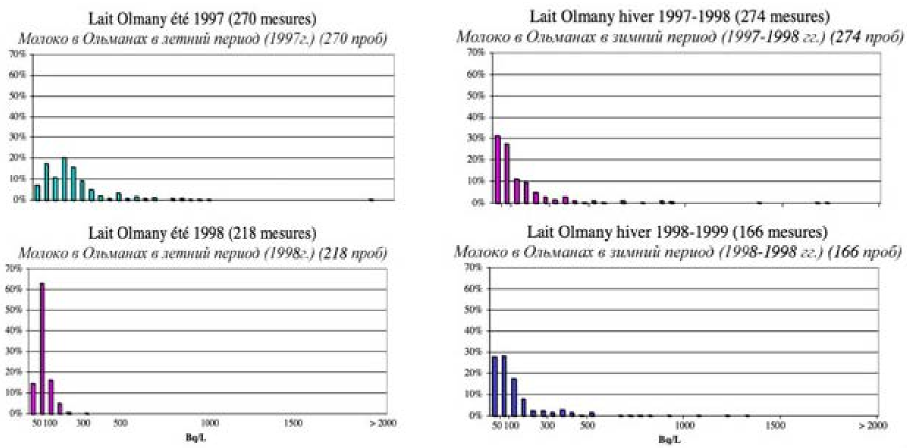
To answer these questions, the first step was the development of a common understanding of the organization of the milk production in the village by drawing up a clear picture of the situation (Figure 5). The ETHOS team together with the farmers analyzed the existing results of milk contamination obtained for the year 1995 gathered by working with the radiometrist of the village. The results were then discussed with the population, using graphs which showed that the milk produced in the village was not uniformly contaminated. Part of the milk was extremely contaminated, but in low proportions, while the majority of milk exhibited levels of contamination ranging from 200 to 400 Bq per liter (^{137}Cs). Finally, a proportion of milk was found to be below the marketing level of 100 Bq per liter. According to these findings, a group of volunteers, the "milk group" comprising a dozen peasant farmers breeding one or several cows for milk production, decided to focus on the improvement of the radiological quality of milk for children.

FIGURE 5. Understanding the grazing organisation (photo: J. Lochard).

One of the main aspects of the private milk production in the Olmany region was the contrast in practices between the summer and the winter periods. In summer, the milk production was organized collectively: the cows were assembled into herds. In Olmany there were 7 herds representing approximately 400 privately owned cows. Each herd was allocated a specific pasture on the outskirts of the village by the collective authorities (the kolkhoze). Each herd was led daily to its pasture, following the same itinerary through the village and the forest. In winter, the situation was completely different. The cows returned to their sheds next to the family homes and each producer managed his or her fodder on an individual basis. The resources of hay usually came from different sources: part of the hay can be provided by the kolkhoze, from its pastures, the rest being directly collected by the peasants in different places from the outskirts of the village (forest, private patches of arable land, etc.), or even bought in other villages. As a result, the contamination of the hay could vary enormously between different families.

In summer, herds had grazing patterns which crossed many different areas where grass contamination could vary significantly. Moreover, each farmer may feed his/her animal with additional foodstuffs produced at home. Taking into account this complex arrangement, it was decided by the group to adopt a pragmatic approach to assess the radiological quality of all the pastures allocated in summer to private herds, as a function of the levels of contamination in the milk produced by the cows put out to grazing. This was termed “milk mapping” elaborated by the “milk group”, starting with a simple map of the village, representing the geographical location and name of each pasture and the corresponding herd number. Discussions with experts from the Institute of Terrestrial Ecology (Cumbria, United Kingdom) enabled the elaboration of a protocol for milk measurements, which ensured that the results were statistically robust/sound, giving a realistic appraisal of the radiological situation, reliable enough to identify possible practical means to improve the situation, but also taking account of local constraints. The milk group finally decided that the radiological quality of a given pasture could be assessed once for the summer period by measuring the contamination of the milk produced by a reasonable sample of 30-40 cows per herd grazing on this pasture. If the herd changes its pasture in the course of the summer, the operation must be repeated once again, making sure that measurements of milk are performed after at least 2-3 days of grazing in the new pasture waiting for the milk contamination to reach an equilibrium.

The follow-up study of milk contamination in winter was carried out on an individual and continuous basis throughout that season. Since the diet of animals could vary significantly, the radiological quality of the milk could also vary. A few farmers from the “milk group” were volunteers in an effort to find a way of optimising their resources in order to improve the quality of the milk. In the first stage, each farmer performed a radiological assessment of his/her available feeding reserves (could also say “fodder”)? As they gathered and stored the hay in their sheds during the summer period, they measured its contamination and separated out hays of different origins and contamination levels, into different stacks, according to the quantity. Then, using a simplified optimisation model elaborated by the group, they planed the future winter production, managing the feeding of animals according to the hay contamination and other parameters and constraints such as: calving and milking periods; the availability of complementary feed or Ferrocyn to reduce the transfer of caesium to milk. A periodic follow-up of the milk allowed each farmer to check the radiological situation and to change the feeding regime of the animals during that period if the contamination of milk deviated from the forecasts. The assessment of the hay resources had to be performed before the winter started. The volunteers had to divide the hay originating from different locations into separated stacks. Next, they had to measure the contamination and to evaluate the quantity (mass) of each stack. Then, according to the calving period, they could plan animal feeding, giving the animals the most contaminated hay during the periods when milk was not consumed by the children, and keeping "clean" hay for the milking period. A monthly follow-up of the situation was organized, to measure the milk and, at the same time, to note the type of hay used to feed the animal, checking the contamination of this hay (see Figure 6).



Summer 1997 Winter 1997/1998

FIGURE 6. Improvement of the quality of the milk in summer (left) and in winter (right) (CEPN, 2002).

For the summer production, once the measurements of milk contamination had been carried out for all the herds, the results gathered by the radiometrist were evaluated using graphs which were displayed on posters in the village. This informed the population of the work that was being carried out and discussed in the "milk group". These results showed that the radiological quality of the milk from five herds was relatively good while the milk from two herds, which were partly grazing in forest areas, was highly contaminated. It was then a priority for both the population and the local authorities to find a solution for these two herds. The results also demonstrated for the other five herds, the positive effect of the improvement of pastures being performed by the authorities and about which the population had often expressed doubts in the past. The improvement of pastures was one of the agricultural countermeasures taken after the Chornobyl accident to reduce the amount of contamination transferred to the grass and, as a consequence, to the milk. It consisted of ploughing pastures, applying fertilisers (nitrogen, phosphorus and potassium) and sowing new grass.

The co-operation of local actors, peasant farmers, the radiometrist and the kolkhoze together with the ETHOS team in the evaluation process contributed to the re-establishment of a certain trust, especially between the peasants and the kolkhoze, as they could put more faith in the results and acknowledge the reality of improved pastures. Moreover, the results, obtained jointly and presented on clear graphs, provided the local stakeholders with a new bargaining power. In particular, it facilitated negotiations with regional and national authorities, and resulted in the allocation of specific resources to the kolkhoze to improve new pastures and re-organize the allocation of fields to villagers. Finally, the two herds showing problems could graze on improved pastures starting from mid-summer 1997, thus leading to a significant reduction in the contamination of privately produced milk in the summer period. Within the village, ^{137}Cs contamination in almost 80% of the privately produced milk dropped to less than 100 Bq per liter in summer 1998, compared with less than 10% in summer 1997. Parallel to the improvement of the quality of the privately produced milk in summer, the work carried out with the "milk group" on the optimisation of winter production, revealed that the farmers were progressively developing a practical know-how on the management of the radiological quality of milk at the individual level for the winter production, and at the collective scale for the summer production. For the peasants involved in the optimisation work, the radiological measurements started to be used as quality indicators, to explore real problems and to follow-up the production quality. Finally, certain families adapted their milk consumption habits throughout the year according to levels of contamination in milk as well as modifying the feeding regime of their animals. The cooperation between the milk group and the ETHOS team allowed the improvement in radiological quality of the privately produced milk and as a consequence the regional dairy for milk and its derivatives, based in Stolyn, decided to support the peasant farmers in Olmany by re-establishing the trading of their milk production. The dairy facilitated the process of collecting the milk in the villages and also offered better conditions of payment.

Finally, the integration of the dairy in the process, with its own means of measurement, was also a guarantee of the sustainability of the radiological quality of the milk.

Stimulated by the interest of the dairy in buying private milk again, the local authorities encouraged an increase in private production, and as a result the kolkhoze provided peasant farmers with a surplus of hay during winter 1997–1998. Consequently, at the end of this winter, about 56% of the private milk had a ^{137}Cs contamination of less than 100 Bq per liter compared to approximately 25% in winter 1996–1997. On the scale of the village, the potential for production of non-contaminated milk by peasant farmers was drastically increased between 1996 and 1999.

Beyond these tangible results, the improvement in the radiological quality of the milk has led to significant changes in the quality of life in the village. A good example includes a shift in the attitudes of the mothers involved in the project and a reduction in internal contamination among children as described previously. The results of the milk group also inspired new practical teaching methods to be implemented in schools, as well as the improvement in the radiological quality of pork.

2.3. *Summary of the other working groups set up in Olmany*

The villagers had a tradition of drying pork and selling it at the Stolyn market. After the disaster, the meat, contaminated because the animals were primarily fed milk produced in the village, could no longer be sold at the Stolyn market, resulting in a significant loss of income for the farmers. The ETHOS team, in collaboration with a group of farmers, worked on several solutions to reduce meat contamination. However, it was only after the milk problem was resolved through improvements in animal feed (see previous section) that meat sales could partially resume.

Several teachers at the Olmany school were involved in the young mothers' and milk working groups. As the results from the groups became clearer, they suggested using them to teach the school children. First, they taught the children how to use a dosimeter and they organized field trips in and around the village to measure ambient dose rates. Then they gradually introduced exercises during school classes relating to the radiological situation in Olmany (writing, mathematical calculations, historical research, etc.). The teachers noted a great interest from the children to better understand their own environment. They also noted that as the children acquired practical knowledge of the radiological situation in the village and how to deal with it, this knowledge eventually spread to the parents as well. The teachers reported on the communication that was established between school children and the inhabitants of the village in terms of collecting information on the history of the accident and its consequences on the daily life in Olmany (see Figure 7).

FIGURE 7. Excursion of school children (photo: J. Lochard).

When the people of the village embarked on the measurement of radiation, they quickly identified that the ambient dose rates in the wood stoves were much higher than the average in homes due to the presence of ash resulting from the combustion of wood from the forest. They were concerned by this, and raised the question of whether this posed a problem because the ashes were usually spread on the gardens to fertilize them. It was therefore decided to create a working group in which inhabitants and several forest guards got involved. The group sought to know whether the spreading of ashes posed a problem, and if it did, whether there was the option of using "clean" wood. The solution finally adopted by the villagers in order to avoid dissemination of radioactivity in the local environment, was to no longer spread the ashes but to collect them and bury them in holes dug in the vegetable gardens.

It is interesting to mention that during the first two years of the ETHOS project the young people of the village did not show any interest in the activities of the groups already formed. It was by chance that during a walk, while one of the French experts was filming a video of the village to show to his family, that a conversation began with a group of young people curious about the camera. The conversation led to the idea that the ETHOS team would bring the suitable equipment during its next mission so that the young people could make the film themselves. The result of the group of young people was the realization of the film with the help of the ETHOS team during which interviews of the villagers were performed, notably on the current activities of the working groups set up within the ETHOS project. This film was presented one evening in the village community hall and was a great success.

All these initiatives demonstrated that managing situations of persistent environmental contamination cannot be considered separate from the local way of life. It requires all stakeholders to establish new connections with their environment and with the local community, to understand radiological risk as one aspect among others in the complex process of improving living conditions, and to give new meaning to daily radiation protection activities. These aspects constitute a legacy to be passed on future generations.

3. The extension of the ETHOS project and the concluding International Seminar

In 1999, the Stolyn district authorities and national authorities requested the ETHOS team to implement the ETHOS approach with the local population in four other villages in the district: Belaoucha, Gorodnaya, Retchitsa, and Terebejov, which, like Olmany, were particularly affected by the contamination (Figure 8). This led to the extension of the ETHOS project for two consecutive years until autumn 2001.

In each village, the ETHOS team involved residents and local authorities like in Olmany but the role of the team was to train and support local professionals in implementing specific projects in the villages, based on the Olmany experience. While in the context of Olmany the members of the ETHOS team were heavily involved in local projects, in the second phase of the ETHOS project in the 4 villages, the involvement of the inhabitants was primarily overseen by local professionals — that is, individuals who were both village residents and representatives of a professional sector or who held an administrative position within the village. These individuals facilitated the development of the practical local projects involving the population focused on three main areas: improving the radiological burden of children, marketing and producing food products with good radiological quality — particularly potato production, developed especially by the Belarus Institute of Soil Science and Agrochemistry-BRISSA (Bogdevitch, 2003) — and finally, developing a practical understanding of radiological risk among young people through village school teachers. In total, approximately 80 professionals and specialists — collective farm managers, doctors, nurses, teachers, and radiometrists — volunteered in the five villages, including Olmany.

Finally, a seminar was organized in March 2000 in Stolyn for the initial training of these participants. The organization of this seminar was handled by the Stolyn district (CEPN, 2002). The ETHOS team was responsible for preparing the seminar content. The seminar took place on November 15th and 16th, 2001 at the Stolyn Agro-economic College, with 150 participants in attendance representing the local, national and international levels under the title "Rehabilitating living conditions in territories contaminated by the Chernobyl accident: the contribution of the ETHOS approach. The seminar had several objectives. Firstly, to present the results of the working groups in Olmany and the 4 other villages with input from the ETHOS team. Secondly, to debate with representatives from the International Community the ETHOS approach for developing sustainable rehabilitation of living conditions within the contaminated territories in Belarus.

FIGURE 8. Photos of the Stolyn seminar (photos: J. Lochard).

In his introductory address, the President of the Stolyn District said "*We can therefore say that we appreciate the approach developed by the ETHOS project because it is a new approach, whose goal is to change the situation by providing targeted information to well-defined groups within the population, rather than general information that affects no one. I must say that this project has achieved its objectives.*"

At the end of the seminar the participants adopted a text with the title "Conclusions and Recommendations of the International Conference held in Stolyn – Republic of Belarus" calling upon the departments of the Belarus administration concerned, as well as international organizations, to envisage a long-term cooperation in the area of the rehabilitation of living conditions in the territories of the Republic affected by the accident, particularly in relation to economic aspects with the overall objective to develop a new project that would take into account the experience of the ETHOS project and that would bring together sustainable economic development and radiological rehabilitation.

Conclusions and Recommendations of the Stolyn Seminar

Text adopted by all seminar participants on November 16, 2001.

The seminar brought together representatives of the Chernobyl Committee attached to the Soviet of Ministers of the Republic of Belarus, the Ministry of Education, the district and oblast authorities, managers and professionals from the collective farms (kolkhozes), residents of contaminated localities, scientists from the National Academy of Sciences, the Academy of Agrarian Sciences, representatives of the European Union, the European Commission, the UNDP, the World Bank, members of the European interdisciplinary group ETHOS, and other representatives of international NGOs.

The seminar participants reached the following conclusions:

1. Many health, environmental, economic, and social problems caused by the accident in Belarus are long-lasting and remain a focus of attention for the administration of the Republic, researchers, and the global community. A series of factors, in particular the deteriorating economic situation, the disintegration of the USSR, etc., have exacerbated the consequences of this disaster. A decisive factor is also the lack of knowledge among the population that would allow them to independently assess the veracity of information regarding the consequences of the disaster, which is often contradictory, and to take measures to reduce the radiological risks resulting from living in contaminated areas.
2. The large-scale initiatives undertaken by the State have significantly reduced the negative consequences of the disaster. Protective measures in the public agricultural sector ensure production meets standards and ultimately reduce the expected dose of exposure for the population. However, in the private sector, the rate of production exceeding standards remains very high. This is particularly true for forestry products. Addressing these problems requires close attention from local authorities. It is also necessary to consider improving existing approaches and

developing new methods in collaboration with the community. For the protection of children, measures adopted in the agricultural sector must ensure production meets the latest international standards for radiological exposure.

3. The complex problem of restoring living conditions in contaminated areas, which includes re-establishing economic and social activity while ensuring the safety of the population's living conditions, has become the top priority 15 years after the accident. This problem is unparalleled in history due to its complexity and scope. The current moment is characterized by an intense search for approaches to solving the problem of rehabilitation. Furthermore, it is important to continue research concerning the health of the inhabitants of contaminated areas.
4. In light of the above, the approach of the ETHOS project, funded by the European Community and implemented since 1996 in the Stolyn District, deserves to be studied, developed, and disseminated. This approach is complementary to the Belarusian State Program concerning the consequences of the accident. It is based on the involvement of the local population and specialists in managing the radiological situation, which requires the development of a specific radiological culture concerning life in the contaminated areas. The effectiveness of this approach has been confirmed in practice, as well as in this seminar, using the villages of Olmany, Gorodnaya, Belaousha, Terebejov, and Retchitsa as examples.
5. The seminar participants call upon the relevant agencies of the Belarusian administration, as well as international organizations, to consider long-term cooperation in rehabilitating living conditions in the areas of the Republic affected by the accident, particularly in the economic sphere. One direction would be the development of a new project that takes into account the experience of the ETHOS project and combines sustainable economic development with radiological rehabilitation.

Finally, The ETHOS project was a turning point in the rehabilitation policy of Belarus. It paved the way to the formalization of the "co-expertise process" that has been refined first during the development of the CORE Programme (2004-2009) (see Lochard et al., 2026), and later on in the affected areas of Fukushima (see EDP Sciences, 2026).

Concluding remarks

The ETHOS project officially ended in November 2001, but the ETHOS team continued its work in the Stolyn district, in the five villages concerned, within the framework of the CORE programme, both during the preparatory phase (two years) and during the implementation phase, until 2009. The residents of the villages of Belaoucha, Gorodnaya, Olmany, Retchitsa, and Terebejov, were involved in many projects, particularly in the priority areas of agricultural development, health, radiological quality, education and memory continuing the activities they initiated in the ETHOS project (see chapter 2). After the CORE programme, more sporadic missions were organized in the Stolyn district until the Fukushima accident in 2011. Several Belarusians, including local professionals from the district, participated in the ICRP Fukushima Dialogue between 2011 and 2014 to testify about how they went through the recovery process. Finally, several of the protagonists of the ETHOS project testified about their experiences in the documentary film "Chernobyl Fukushima: Vivre Avec" by Olivier Julien (Julien, 2016) presented in 2016 on the Franco-German TV channel ARTE on the occasion of the 30th anniversary of the disaster.

Towards the end of the documentary, Raissa Missoura, the female doctor and Head of Pediatrics at Stolyn Hospital who followed all the children in the district during the ETHOS project, states, "I remember the age when there were over 200 school children in Olmany with high radiation levels. But over the last 3 years, we have not detected a single person with a level above one millisievert. We are very happy about that".

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