Green and khaki, new environmental technologies at the service of the army

military-Earth thinking notebook

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L'Armée de Terre dans la société

In this well-argued article[1], the author shows us that the environmental dimension is not only now unavoidable in armies and in the Army in particular, but also that it can bring real added value to modern operations.

[1] The remarks, comments and reflections contained in this article are solely those of the author in a personal capacity and do not correspond to any official position.

For the French Ministry of Defence, the environmental dimension has long been imposed only on the issues of physical infrastructures and sites, whether it is a question of protecting the natural areas included in military bases and camps or of bringing the Ministry's buildings up to energy standards. However, with the multiplication of external operations (OPEX), from Afghanistan to Mali, and the increasing consideration given to environmental issues in strategic thinking, the environmental dimension has become increasingly important.environmental security issues, such as the future impact of climate refugees on the French overseas communities in the Pacific or theThe environmental issue has logically become an integral part of armament programmes and capability requirements, to the point where it is now a key issue in any consideration of the future equipment of forces.

In fact, since December 2007 and the establishment by Hervé Morin, Minister of Defence, of the Ministry's Environmental Action Plan, the issue of the link between environmental security and capability requirements has become so important that it is now a key element in the operational success of our forces. At the same time, the principles of sustainable development have affected the rules of engagement in theatres of operations and have led to the prohibition of the use of certain weapons (bacteriological, chemical, anti-personnel mines, etc.).

This integration of environmental issues into military and capability issues has also been reinforced by the need to respond to the reductions in the armed forces' budget resources over the last twenty years. Reducing energy consumption has thus become a major challenge for our forces over the years. Indeed, in the field of energy, the **Ministry**

of Defence presents an atypical and unbalanced profile compared to all other ministries, due to the very particular place of the armed forces in the energy sector.Operational fuels account for 70% of the French Ministry of Defence's expenditure in tonnes of oil equivalent (toe), compared with around 30% for all other forms of energy. Because of this significant consumption of aviation fuel for operational purposes, the Ministry of Defence, which is still the State's largest consumer, must contain its overall energy expenditure around one billion euros per year on average.**An energy performance strategy has therefore been** drawn up since March 2012 to implement a real gaspi hunt and a more reasoned energy use of equipment.

But more than budgetary issues or pollution problems, the environmental question has become a key issue in the capacity debate through the use of "green" technologies, often civil or dual-use. They have been integrated into the PP30 through the eco-design of operational equipment and have become a means of:

- reduce the environmental signature of our forces
- develop technologies capable of limiting the energy costs of forces in operations
- use "green" technologies that enable greater autonomy in the field of energy supply supply chains in hostile theatres of operation
- integrate "green" technologies into land-based equipment that provide an operational advantage over the adversary.

The army is obviously the first to be concerned by these four different issues, while the "green" component compatible with its needs is not a matter of course.

Reducing the environmental signature of our land forces: is this desirable from an operational point of view?

The concern to limit environmental degradation is all the more important today because it goes hand in hand with other phenomena affecting the overall prosperity of our societies in the longer term, whether it is a question of reducing the environmental footprint of our land forces or of reducing the environmental footprint of our land forces.The need to limit environmental degradation is all the more important today as it goes hand in hand with other phenomena affecting the overall prosperity of our societies in the longer term, whether it be de foresting (18 million hectares disappear every year in the world), desertification affecting 1/6 of the world's population, the reduction of biodiversity or tensions over access to natural resources, the reduction of fishery products or the limitation of the quantity of available drinking water.

However, the manufacture of armaments for the army is obliged to take this context into account, because the acceptability of public opinion for a military operation includes the following considerations.However, the manufacture of weapons for the army has to take account of this context, because public acceptability for a military operation also includes this dimension, whereas, for example, the maintenance of vehicles with regard to the environment is becoming increasingly costly for the forces, which have to avoid major discharges of anti-corrosion paint, which inevitably pollutes the environment.

This awareness arose from the wars in Iraq in 1991, where the Americans fired 30 mm depleted uranium PGU-14/B API shells from the GAU-8 Avenger gun equipping the A-10 Thunderbolt attack aircraft, and from Kosovo in 1999. Various studies have focused on the visible consequences of failing to take the environment into account in the use of munitions, with lasting soil pollution and the presence of munitions waste which is likely to pollute the water and soil used by the civilian population in a context of reconstruction

and the restoration of peace.

Limiting the use of polluting ammunition is a real constraint for land forces, since these environmental protection constraints already limit combat training in real conditions on national territory and the use of ammunition. The idea is therefore not to develop "green" armament as such, but to prevent armament from having lasting and unbearable environmental consequences for the generators of weapons.The idea is therefore not to make "green" armaments as such, but to prevent armaments from having lasting and unbearable environmental consequences for future generations, especially in regions where our land forces may be engaged in long-term peacekeeping or peacemaking operations. This is a challenge that Nexter must face when manufacturing shells for French artillery and armoured vehicles, for example the BONUS anti-tank shell with target detection for the CAESAR gun.

However, this "sustainable" policy is not without risks for our land equipment. Compliance with environmental constraints may lead to a reduction in the performance of equipment with a lower shell penetration capacity due to the abandonment of the use of heavy metals, and to a reduction in the effectiveness of explosives, which have become more stable but less powerful. The principles and constraints of sustainable development can therefore adversely affect the rules of engagement in theatres of operation by leading to the prohibition of the use of certain weapons, which is not the objective sought for our forces.

Developing technologies capable of limiting the energy costs of land forces

In 2007, the Ministry of Defence launched the "Defence 3D" (sustainable development defence) programme, where the ISO 50001 "energy management" standard is increasingly present. Both equipment and bases are concerned [1]. As an example, in December 2015, at the Valbonne military camp, where the 68th African artillery regiment is stationed, ISO 50001 became the standard. A contract worth twelve million euros now makes it possible to achieve a high level of energy performance for this base of 3.000 people, and the coal-fired power plant has been replaced by a sustainable infrastructure built and managed by ENGIE Cofely, the company in charge of the project, with the objective of reducing greenhouse gas emissions by 60%.

Apart from the specific case of energy supplies to army bases, three areas of effort have been made in terms of equipment: developing new fuels, improving the efficiency of combustion engines and reducing vehicle weight. It is on this last point that the effort has been focused in recent years on land armaments, as this is the factor that has a decisive influence on fuel consumption. Thus, the TITUS[2] armoured vehicle, developed and designed by Nexter in 2012 on the basis of a Czech Tatra truck, weighs seventeen tonnes (it can go up to twenty-seven tonnes) and can transport fourteen men while being truly all-terrain. This logic of optimising the mass of the equipment has been adopted and extended as part of the SCORPION programme. It is integrated for the future 319 GRIFFON multirole armoured vehicles and for the 20 JAGUAR armoured reconnaissance and combat vehicles (both 25 tonnes), for which Nexter, Renault Trucks Défense and Thales were notified of the order by the DGA in April 2017, and which will replace the VAB and AMX10RC respectively.

Using "green" technologies that enable greater autonomy in the field of energy supply logistics chains in hostile theatres of operation

The future FELIN (infantryman with integrated equipment and links) fighter program, piloted by Sagem Defence and Security, part of the Safran group, is committed to energy savings. In November 2013, in an interview given to the Army technologywebsite [3], Renaud d'Hautefeuille, director of industrial cooperation and offsets for the Sagem group, made it clear that one of the major objectives of this program was to make the soldier more autonomous in relation to conventional energy supplies. To this end, the Sagem group has developed a unique Lithium-ion battery, with reduced mass and optimized management of the energy available to the infantryman for his radio, his various means of communication and his third-party equipment.

Similarly, another example of the interest shown in these green technologies, one of the contracts in the FELIN program is linked to the Limousin solar panel manufacturing company DisaSolar. This contract was signed on 12 July 2012 with the Ministry of Defence for the development of flexible and mimetic solar panels, with the CEA/INES and the CNRS/XLIM, capable of adopting the shapes and colours of theThese panels are capable of adopting the shapes and colours of the environment in which they are deployed, to discreetly provide combatants in operations with energy from the sun to increase their autonomy and recharge the batteries they use today.

Can the integration of "green" technologies into land-based military equipment provide an operational advantage over the enemy?

This issue is primarily seen as a means of limiting exposure to risks, for example by limiting energy requirements for operational reasons. Afghanistan has shown that energy supply remains a vulnerability in a context where fuel transports are under attack, with a loss of 300 tanker vehicles and more than 1,000 vehicles damaged between 2001 and 2016.

Today, many green technologies are therefore being integrated into land-based equipment, but these are not always operational requirements. For example, teams **from the DGA's materials department have been working on new paints to replace those with solvents with more environmentally friendly paint systems, while retaining functional properties such as infrared discretion. But all this does not give a capability advantage and does not meet an operational need.**

The real question is to determine what, in the so-called green technologies, would make an operational difference and what could be part of a policy of power through the use of green technologies.[4]. However, in the areas concerned (cleantechs, environmental engineering, biomass gasification, ecoinformatics, carbon capture and reduction of greenhouse gas emissions), the Commission will continue to work with the Member States on the development of a new European energy policy.missions, mainly solar and wind energy), the impact on equipment is real, but that is not what makes the difference in combat. For the army, as for all other forces, the breakthrough technology that will give it a very high level of energy autonomy may be decisive for the combat of the future. This is obviously the direction in which we must move.[5].

In conclusion, the **links between the world of green technologies and the "khaki" world are increasingly growing. Among the various possible applications for land-based weapons, green technologies will certainly come from future polymers [6] derived from** [living] organisms, **close to** bio-mimicry **technologies**, which will make it possible to create new machines, with complex shapes and properties that can be adapted to the demands and needs of military forces. Green technologies are therefore a major security

issue for the land forces of the 21st century.

1] See the FRS prospective study on these issues: https: //www.frstrategie.org/publications/defense-et-industries/optimiser-l-energie-en-operations-exterieures-1-5.

2] See the Nexter website: http://www.nexter-group.fr/fr/presse-et-evenements/605-nexte-systems-devoile-son-nouveau-vehicule-blinde-6x6-titusr-lors-du-salon-dsei-2013

3] See: http://www.army-technology.com/features/feature-defining-green-defence-cross-border-approach/

4] On this issue, see the TARANIS project presented in March 2016 and funded by the CSFRS: https: //www.csfrs.fr/recherche/projets-en-cours/TARANIS

5] See ONERA's work for 2050 on aeronautical technologies: http: //www.onera.fr/sites/default/files/Departements-scientifiques/DPRA/brochure-ats2050.pdf

6] For example, the Austrian company Glock produces pistols, the first model of which, released in 1980, was the Glock 17. It is one of the first industrial guns to incorporate polymers. Thanks to these materials, the gun is lighter and less sensitive to corrosion. The flexibility of the materials makes its recoil less brutal than with the rigid frame of a weapon of equivalent weight.

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