AMERICAN Journal of Science on Integration and Human Development
Volume 3, Issue 11, 2025 ISSN (E): 2993-2750

Units of Foreign Armies Experiments in the Transportation of Material Vehicles When Conducting Special Movements in Mountainous Conditions

Major Mukhtorov Rustam Rakhim ugli
University of Military Security and Defense of the Republic of Uzbekistan, Student of the Faculty of the General Staff of the Armed Forces

Abstract: This article briefly covers the experience of troop units of the USA, Germany, India, Austria and Switzerland in transporting material resources during special operations in mountainous conditions.

Keywords: mountain, conditions, material resources, traditional resources, logistics, mule, horse, robot mule, helicopter, heavy load, drone, modern technologies, special units.

Transporting material assets in mountainous conditions is one of the most difficult logistical tasks for foreign armies. In this regard, they use a number of traditional and innovative methods.

The following are the main approaches and experiences of foreign armies in organizing material and technical support in mountainous areas:

1. Traditional and adaptive means of transport

Packing animals (especially mules): Many armies, for example, the Indian Army (when delivering supplies to its forward posts in the Himalayas), have long used pack animals (mostly mules). They are very effective in transporting heavy loads in off-road, steep and snowy conditions. For example, the Indian Army has traditional animal transport units.

Special vehicles: Light and medium-tonnage vehicles with four-wheel drive, with high cross-country ability, designed for climbing high mountains, moving on narrow and slippery roads.

Mountaineering units: Mountaineering units in countries such as Germany, Italy, and France are specially trained to carry loads on backpacks or special ski-like towing devices (especially in winter).

2. Air transport and airborne methods

Helicopters: They are the main means of supply in the mountains. They provide rapid, vertical transport and can operate independently of road infrastructure. Helicopters carry out transport activities using the following methods:

1) full landing and unloading;

2) hovering and unloading (if there is no landing site);

3) external suspension: Transporting very heavy or large loads by hanging them under the helicopter. This can be faster and safer.

Drones: Many militaries are testing robotic mules and cargo drones to deliver small but important loads (such as medicine, ammunition, water, batteries) to remote and dangerous mountain locations.

For example, the Indian Army is planning to replace traditional mules with artificial intelligence-based robotic mules and military drones.

Airdrop: The dropping of large quantities of supplies into a designated area using parachutes. Special packaging techniques are used to prevent damage to the cargo.

3. Logistics infrastructure and technological innovations

Modular warehouses and supply points: In mountainous areas, intermediate points and small supply depots are established to shorten the supply chain as much as possible. These points are usually located near transport hubs or helipads.

Personal flying devices: Some special forces units, such as the British and French armies, are testing these devices for rapid and vertical movement of soldiers. Although they cannot carry large loads for now, in the future they may allow for rapid transportation of loads in the "last tactical mile".

Geographic information systems (GIS) and terrain analysis are used to determine the safest and most efficient supply routes.

The main challenges foreign armies face when transporting material assets in mountainous conditions are:

- difficult terrain: steep slopes and ravines that vehicles cannot cross;
- weather conditions: strong winds, fog, avalanches and icing limit the movement of air and road transport.
- security: supply routes may be open to enemy attack.
- long distances: the longer the distance between supply bases and forward posts, the more expensive and complex the logistics.

Foreign armies are paying great attention to *new technologies* to automate dangerous and heavy cargo transportation tasks in mountainous areas:

Carrier drones. Deliver supplies over the so-called "last tactical mile", that is, over short but extremely dangerous distances from the supply base directly to the combat point. Ensures the safety of human life (enemy bullets, rockfalls, etc.). Moves faster than a car or foot. Delivers supplies directly to areas where there are no roads. So far, most drones have limited payload capacity and battery life decreases rapidly at high altitude. They are used for light but vital cargo such as medical supplies, essential ammunition, and optical devices.

Robotic mules. They replicate the tasks performed by pack animals - transporting large loads over difficult, uneven, rocky, and forested terrain. Their advantage lies in their carrying capacity. They are capable of carrying much heavier loads (sometimes hundreds of kilograms) than drones. They also have a longer operating time. They can cover long distances using internal combustion engines or efficient batteries. They can also move autonomously. They have the ability to independently follow soldiers or move along a predetermined route using GPS and sensors.

The US, Chinese, and Indian armies are currently testing such robotic platforms in mountainous conditions. Their main purpose is to transport heavy loads such as shells, water tanks, and large amounts of fuel for mountain artillery.

The Indian Army's expertise in transporting supplies, especially in the high altitudes and harsh climatic conditions of the Himalayas, is unique. They combine traditional and modern methods:

Traditional expertise: Pack mules. Delivering food, weapons and construction materials to the front lines in mountainous areas, especially points above 10, 000 feet (about 3, 000 meters) where road infrastructure is not available. Mules have high mobility on steep slopes, narrow paths and in snowy conditions, and are much more reliable than human power or some mechanisms. The Indian Army plans to phase out traditional animal transport units by 2025 and replace them with modern technology. This marks the end of a long history of using mules.

Modern expertise: high technology.

Helicopters: Remain the main means of transporting large volumes of cargo quickly and efficiently in mountain ranges. They are particularly vital in supporting forces in border areas. The Indian Army is undertaking a $600 million defense modernization to enhance its supply capabilities in the mountains. Part of this funding is being channeled into high-tech logistics solutions, such as robotic mules and drones.

The 23rd Mountain Infantry Brigade of the German Army (Bundeswehr) has a unique wealth of experience in organizing logistical support in mountainous conditions.

The German mountain infantry is not just a regular combat unit, but also highly skilled soldiers who specialize in operating in extreme conditions (winter warfare, polar, mountain and desert conditions). Their logistical approach is based on a combination of traditional solutions and special technical means.

1. Traditional logistics. "Gebirgstragtierwesen 230" is a mountain pack animal unit. The German mountain infantry brigade is the last unit in the Bundeswehr to use horses (Haflinger mountain horses) and mules. They are used to transport heavy loads and supplies to the front lines in mountainous areas, especially where roads are not available (according to the experience of NATO missions in places such as Afghanistan and Kosovo). The advantage of mules is that they can move steadily on narrow, steep and icy paths that high-tech vehicles cannot. They can survive for long periods on only mountain pastures and water, which keeps their logistical footprint to a minimum.

2. Special vehicles. The German army uses a special articulated tracked vehicle called the Bv 206 (Bandvagn 206) for mountainous and snowy areas. This vehicle has excellent cross-country ability in snow, ice, mud and rocky terrain. It can effectively transport not only soldiers, but also cargo. Also, the military version of the Unimog trucks with high cross-country ability are used as the main heavy-duty transport vehicle on relatively good roads in the mountains. In addition, small and light tracked armored vehicles called the Wiesel AWC (Airborne Weapon Carrier) can be used for rapid support and supply transportation in mountainous conditions.

3. Infantry logistics and skills. Each mountain infantry battalion has a special unit for combat operations and reconnaissance in the high mountains. These soldiers have the highest level of skills in transporting supplies using skis and ice axes. They are trained to minimize their own supplies and use local resources, which reduces dependence on the logistics chain. The German 23rd Mountain Infantry Brigade uses helicopters and special tracked vehicles as a base for transporting supplies in mountainous conditions, while relying on mules and highly trained infantry to deliver supplies in the most difficult areas where vehicles cannot pass.

The US military's experience in organizing logistical support in mountainous conditions in Afghanistan is a very complex and expensive approach.

US forces (USFOR-A and ISAF/NATO) operated mainly in extremely steep and dangerous areas such as Kunar and Nuristan, located in the Hindu Kush mountain range, which is the western part of the Himalayas.

The main US strategy was to rely on air superiority and heavy armored vehicles, but this created unique problems in mountainous conditions:

1. Complete dependence on air transport. In mountainous areas, especially in narrow and long valleys/canyons like Kunar, the main means of supply was helicopters. Because the roads on the ground were too narrow, poor or non-existent for mine-resistant armored vehicles (MRAPs) to pass. More than 90% of supplies to small forward posts (Combat Outposts - COPs and Forward Operating Bases - FOBs) were delivered by air, mainly by helicopters. The main risk was that helicopters were easy targets for enemy fire and surface-to-air missiles (although the risk was low). Also, the high altitude and high summer temperatures significantly reduced the helicopters' lifting capacity. This meant that less cargo had to be carried or less fuel had to be taken on a single flight. In addition, delivering supplies by air was tens, sometimes hundreds of times more expensive than delivering them by road.

2. Road transport restrictions or long supply chains. Since Afghanistan is a landlocked country, most supplies were initially brought in thousands of kilometers across Pakistan (or via northern routes). Attacks, roadblocks, and corruption were common on these routes. The US used huge, mine-resistant trucks (MRAPs) to protect supply convoys. Although these vehicles were effective in protecting against mines, they were too heavy and cumbersome to navigate the narrow and poor-quality roads of the Afghan mountains. Supply convoys were often targets for improvised explosive devices. As a result, logistics operations often became combat operations against the enemy.

Since special operations forces were smaller, they tried to operate with a minimal logistical footprint, relying on highly trained personnel and modern technology. They often used air (helicopters and drones) and light trucks.

The most important conclusion from the US Army's experience transporting supplies in mountainous conditions in Afghanistan was that delivering supplies by helicopter and road was extremely expensive and dangerous, demonstrating the need to develop minimal but highly effective technologies (drones, robots in the future) for forces operating in mountainous areas.

The experiences of the Austrian and Swiss armies in transporting material resources, which were the founders of the history of warfare in mountainous regions, are similar to the German experience, but have their own unique aspects.

Experience of **the Austrian** Army (Bundesheer). Austria is a country with a historical experience of mountain warfare, and its army specializes in defensive operations in the Alps. The 6th Mountain Brigade (6. Gebirgsbrigade) is the main mountain unit of the Austrian Armed Forces, specializing in operations in medium and high altitude mountainous areas. Like Germany, the Austrian Army has a long tradition of using pack animals (mules/horses) for mountain logistics. These units are essential for transporting supplies over poor roads and steep slopes by traditional methods.

The Austrian Army is one of the most rigorously trained in mountain warfare among Western armies. They participated in the Mountain and Winter Warfare School, together with Germany. This focuses on infantry logistics skills, such as carrying supplies in backpacks, on skis or towed (in winter). Austria has joined NATO's Mountain Warfare Centre of Excellence, which means that it is committed to bringing its expertise to international standards and developing modern mountain logistics methods.

The Swiss expertise is mainly focused on national defense in mountainous areas. Their logistics are aimed at ensuring autonomous and long-term operations in the most difficult mountain conditions. Switzerland has a Centre of Competence for Mountain Warfare. This centre is responsible for ensuring basic and operational training in difficult conditions.

Swiss logistics in the mountains are based on the principle of "having a means of movement". This includes:

- each soldier must carry a load (food, water, weapons, special equipment) not exceeding one third of his weight over long distances;

- Although helicopters are the main means of rapid supply, their logistics system pays great attention to the placement of loads in a light and modular manner;
- Swiss mountain guides use special formulas that calculate the total time it takes for soldiers to move in the mountains (including the energy spent on transporting loads);
- Like Germany and Austria, Switzerland also uses special mountain horses (for example, Freiberger) to transport supplies in the most difficult conditions.

The experience of foreign countries can be studied more easily through the following comparative table:

Feature	USA (Afghanistan experience)	Germany (Gebirgsjäger)	Austria / Switzerland
Key features	Technology and air superiority.	Combination of tradition and special equipment.	Infantry autonomy and defense.
Vehicles	Helicopters (CH-47/UH-60), MRAP convoys.	Special tracked vehicles (Bv 206) and helicopter.	Infantry, pack animals, light helicopters.
Special equipment	Robotic mules and drones development stage).	Pack mules (“Tragtierwesen”) and Unimog.	Pack mules/horses, ski and rope systems.
Challenges and issues	Logistics costs and risk of enemy attack.	Maintaining a pack animal unit.	Long-term autonomy in extremely difficult conditions.

In short, foreign militaries use a combination of helicopters, pack animals, and off-road vehicles to transport supplies in mountainous conditions, with the goal of automating this process in the future using robotics and drones.