Technological solutions for implementing sustainable cereal-based value-chains in high mountain areas

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**Keywords.** Mountain agriculture, minimum tillage, stripper header, cable traction

**Abstract.** The Brotweg project (“The Bread path for mountain areas”) aimed to develop radical innovations for cereal cultivation in extreme mountain contexts, on land with very high slopes (even more than 80%) where cereal cultivation has so far been precluded to any form of mechanisation, resulting in abandonment due to high labour demands. The need to identify new development models for mountain agriculture, complementary to the currently prevailing zootechnical ones, has brought the alternative of the "cereal chain" (cereal-flour-bread) back to the forefront, compared to the "forage chain" (hay-milk-cheese) for the considerable advantages that the former entails in terms of reduced labour and annual workload, investments and environmental impact. However, the implementation of the cereal chain required the prior resolution of the main obstacles to the adoption of suitable technological solutions for field mechanisation and conservation/management in small farms. The Brotweg project therefore envisaged the development of prototypes to be used for the followings: a) cultivation, with new machines suitable for the steep slopes in the most critical operations (sowing and harvesting); b) post-harvesting and storage of the grain directly at the farm; c) processing, with micro-bakery lines. The whole research was based on integrated evaluations capable of taking into account economic and operational performance, safety conditions for operators, control of erosive phenomena and protection of the landscape, and levels of sustainability of the entire chain.

The project activities firstly have led to the prototype development of machines for the integral mechanisation of field operations, based on a tool-carrying tractor already equipped with cable traction (using an on-board winch) to allow transit and workability even in the most extreme conditions. In particular: a) for sowing, combined minimum tillage solutions were developed (rotary harrow + seed drill on hard ground) able to guarantee germination activity without running the risk of erosion typical of conventional tillage and - above all - without compromising the vitality of the herbaceous essences of existing meadows, while limiting their vigour in competition with cereal crops; b) for harvesting, a stripper header was developed, to allow easier management of the biomass on steep terrain and in the subsequent transport phases.

The entire post-harvest and conservation line was adapted from existing architectural structures to avoid the negative visual impact of external plant structures. Most of the energy sources used were of renewable origin. The paper reports the results of the agronomic and operational performance achieved in two production seasons.