

A partnership between INRAE and BAIF was formed in 2003 to enhance local genetic diversity for sustainable genetic improvement. Since then, genomic selection based on data from the genotyping and phenotyping of reference populations has led to substantial sustainable genetic progress in Europe. A novel genomic selection program has thus been set up at BAIF using state-of-the-art technologies (genotyping, insemination) and the collection of original information to select traits associated with adaptation to harsh environmental conditions<sup>(1)</sup>. **This program makes effective use of genetic diversity to enhance both performance and adaptation and is thereby in line with agroecological principles.** It benefits from a project funded by the Bill

and Melinda Gates Foundation that enables BAIF to collect thousands of phenotypes and genotypes from smallholder farmers in seven Indian states. In 2018, it was extended with the launch of the Genetic Improvement of Indian Cattle and Buffaloes (GIMIC) international associated laboratory (LIA), which also involves AgroParisTech. This LIA contributes to the implementation of technically and economically sustainable genomic selection initiatives tailored to Indian conditions in a system with very marked genotype x environment interactions. It is complemented by technical training for BAIF senior staff.

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#### For further information

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## Food, feed, forage and malt

*Barley is the ultimate multipurpose crop for nutrition and livelihood security in the MENA drylands*

**I**ntegrated crop-livestock farming is the predominant system in the drylands of the Middle East and North Africa (MENA), where small-scale farmers struggle to maximize their farm productivity under climate change. For these farmers, cereal forage, stubble and straw are the main feed source for small ruminants during summer and winter<sup>(2)</sup>. With rising fodder and forage prices, it is essential to breed and grow cereals that target more than just grain yield. In this setting, barley is the perfect crop to increase food and feed security by maximizing the efficiency and resilience of the crop-livestock farming system. **Barley cropping has the dual advantage of producing substantial green forage dry matter in winter—when forage is otherwise scarce—thereby not penalizing the grain and fodder yield in summer.** This

strategy is also more economically profitable than only targeting high grain yield, especially in areas with >300 mm of rainfall<sup>(2)</sup>, while ensuring year-round fodder availability, hence reducing pressure on rangelands. As such, the ICARDA Global Barley Breeding Program has recently developed **new more efficient dual-purpose barley genotypes that produce up to 20% more forage in winter—as compared to the best commercial checks—that can be grazed by livestock**<sup>(3)</sup>. However, maximizing sustainable farming system profitability is also essential to improve farmers' livelihoods, which means that farmers require access to new efficient varieties that could be readily integrated in the targeted agroecological system. Farmers gain higher economic and even nutritional benefit when grains target high value chains, like

biofortified human food or malt production. In recent years, malt demand has increased by 83% in Ethiopia, and new contract farming schemes provide premiums of up to 20% above the market price<sup>(1)</sup>, which has resulted in increased malt barley cultivation. However, some malt barley varieties fail to provide enough straw fodder to fulfill crop-livestock farming system needs. The release of new malt barley varieties that combine superior malt production and straw yield<sup>(4)</sup>, such as ICARDA EIAR varieties (IBON174/3, HBI1963 and HBI1964), can increase farmers' revenues while generating fodder to maximize the overall efficiency and resilience of the farming system.

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▼ *Dual-purpose management field trial in the ICARDA-Marchouch field station (Morocco).*  
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