



Evolution of a Walnut Cracker and Oil Expeller Machine in Nepal

The experience of the project MITO

Nepal's Karnali region, State 6, is characterized by high poverty and food insecurity due to its remote, mountainous nature. Societal norms in rural areas are very traditional and highly patrilineal. Many households face food insecurity for more than 6 months a year and are trapped into a cycle of debt. Nevertheless, the region is developing rapidly, largely due to the Karnali highway, which now connects the Northern part of the State, and notably Jumla, with the rest of Nepal. This increased accessibility, combined with the temperate climatic conditions, offers good prospects for developing a variety of high value commodity chains. This is an important means for contributing both to increased income and food security, and to the broader socio-economic development of the region. Walnut products – both kernels and pressed as oil – are underdeveloped value chains with potential for growth. Of the two main varieties of walnut in Nepal, the cultivated form (eaten as kernels) is known as soft-shelled walnut (*dante okhar*); the form found growing in natural forest is the hard-shelled walnut (*hade okhar*). Traditionally, *hade okhar* is laboriously crushed and ground by hand by women to expel the oil. In 2017, two Swiss students (studying mechanical engineering and a design at ETH and ZHDK, respectively) took on the challenge of developing a mechanical walnut cracker, separator and oil expeller that could be readily used by women. It should be much faster than manual labor, and less physically demanding. The students' goal was to produce a machine that could process 60kg of nuts to 5kg of filtered oil in one day.

Model 1: The Swiss Prototype



Picture: Walnut machine testing at Hanku, Jumla, July 2017.

Intervention	Strength	Areas for Improvement
Introduction of cycle-powered Swiss Prototype Walnut Cracker, Separator & Oil Extraction Machines in collaboration with ETH, Switzerland	<ul style="list-style-type: none"> Reduced workload significantly in cracking of hard-shell walnut particularly for women (i.e. 7 days' work to 1.5 hour <u>only for cracking</u>) People became excited to use the machine to extract oil from hard-shell walnut, previously considered as waste 	<ul style="list-style-type: none"> Unsuitable height for Nepalese people More time consumption for oil extraction High cost Further manual separation required for large volume

Model 2: Modification of Swiss Prototype and developed Nepali Prototype



Picture: Performance test of walnut machine after first modification at Jumla, Dec 2017.

Intervention	Strength	Areas for Improvement
Test of cycle-powered Nepalese Walnut Cracker & Separator Machines (First improvement in collaboration of ETH, Switzerland & Balaju Yantrashala)	<ul style="list-style-type: none"> Suitable height for Nepalese people Separation rate of Kernel from shell ~ 75% 	<ul style="list-style-type: none"> Difficult to rotate crusher smoothly due to difference in manual power High cost (NPR 310,000 for Cracker and Separator) Further manual separation required for large volume

Model 3: Nepali prototype modified with electric motor



Picture: Modified Nepali prototype, September 2018

Intervention	Strength	Areas for Improvement
Test of Electric motor-powered Walnut Cracker and Separator (The second improvement in collaboration with Abhiyan Engineering Consultancy, Kathmandu)	<ul style="list-style-type: none"> • Smooth rotation of Crusher and Separator machines due to uniform electric power • Reduced workload (i.e. 7 days' work to 1 hour for cracking and separating) • Separation rate of kernel from shell ~ 80% 	<ul style="list-style-type: none"> • High cost (NPR 360,000 for Cracker and Separator) • Further manual separation required for large volume

Model 4: Developed Hammer based crusher machine



Picture: Testing the performance of hammer based walnut crushing at Bhaktapur workshop, 2018

Intervention	Strength	Areas for Improvement
Test of Electric motor-powered Hammer based Walnut Cracker Machine (the new model designed in collaboration with Shakya Engineering Workshop, Bhaktapur)	<ul style="list-style-type: none"> • No need of additional separator • Reduced workload (i.e. 7 days' work to <1 hour for cracking and separating) • Separation rate of kernel from shell >95% • Low cost than earlier (NPR 181,000) 	<ul style="list-style-type: none"> • Manual separation required for small volume

Selection of Oil Expeller



Picture: Korean oil expeller for home use(left) & Indian Oil expeller for commercial purpose (right)

Intervention	Strengths	Areas for Improvement
Test of 20-patti Indian oil expeller (as recommended by the engineer and experience from local people)	<ul style="list-style-type: none"> • Easily available in markets (machine and spare parts) • Already adopted in the working area • Multipurpose oil extractor • Reasonable price (NPR 95,000) 	<ul style="list-style-type: none"> • Filter process needs to result in high quality oil • For edible, food grade oil an expelling machine is required

Note: The capacity of the Korean oil expeller was low so it was not selected for commercial purposes.

The four models of walnut crusher, separator and oil expeller demonstrate an iterative process of testing and refining a machine in close collaboration with local people – responding to their needs and suggestions. Further modifications are on-going to reach an ideal model, but each upgrade represents a real advance. Furthermore, the process of developing the model has led to an upsurge in local people’s interest in walnuts as a commercial proposition – both the soft-shelled and hard-shelled varieties.



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