



Jholmal: A nature-based solution for mountain farming systems

Balancing productivity with sustainability

Mountain farmers living in the hilly terrains of the Hindu Kush Himalayan region usually have small landholdings. With growing population and increasing food demands, farmers have resorted to agricultural intensification, with an overdependence on chemical fertilizers and pesticides. But the continuous use of chemicals not only controls the targeted insects/pests but also kills the beneficial ones. This adversely impacts biodiversity, soil health and nutrients, and water quality, ultimately increasing production costs and diminishing farm productivity in the long run. Moreover, consumption of chemical residue on the produce affects public health. Using chemical fertilizers and pesticides is therefore not a sustainable solution.

We need a nature-based solution to balance agricultural productivity with sustainability. With some scientific inputs, a traditionally practised organic solution such as jholmal can provide smallholder farmers with a simple and low-cost substitute to chemical inputs.

What is jholmal?

Jholmal is a homemade bio-fertilizer and bio-pesticide that helps improve crop health and increase yields while reducing the cost of production and use of harmful chemicals. It is prepared by mixing and fermenting locally available resources such as water, animal (cow/buffalo) urine and dung, beneficial microbes, and plant parts in a defined ratio.

Three different types of jholmal can be prepared by using these resources:

- Jholmal-1 provides essential nutrients for plant growth and development.
- Jholmal-2 and Jholmal-3 control insect/pest attacks and protect crops against fungal and vector-borne diseases.

Jholmal provides smallholder farmers with a simple and low-cost substitute to chemical inputs.



Ingredients

Animal urine is used both as a fertilizer and a pesticide. It contains nutrients like nitrogen, potassium, and phosphates. It is also rich in antibacterial, antioxidant, anthelmintic, antibiotic, and antifungal properties. On average, a cow or buffalo excretes 10–15 kg of dung and 6–9 l of urine per day. Dung is generally used to prepare farmyard manure (fertilizer), whereas urine can be either used as a fertilizer or a pesticide in combination with other ingredients.

Jeevatu™, developed by the Nepalese Farming Institute (NFI), is a mix of beneficial microbes found in natural conditions. It accelerates the decomposition process. Jeevatu™ is primarily composed of effective micro-organisms such as lactic acid bacteria, *Azotobacter* species, *Trichoderma* species, phosphate solubilizing bacteria, potassium solubilizing bacteria, photosynthesizing bacteria, and yeast. If Jeevatu™ is unavailable in the market, it can be omitted or replaced by other effective micro-organisms like actinomycetes and fermenting fungi or locally available fresh curd.

Farmyard manure contains macro- and micronutrients that are readily available to plants when it is in liquid manure form.

Locally available plants with bitter, hot, astringent, and pungent taste/odours contain properties that repel or kill various insects/pests or prevent diseases. Parts of such plants can be used to prepare insecticides and pesticides. Table 1 provides a list of such local plants that are commonly found in the mid-hills and high-hills of Nepal.

TABLE 1 LIST OF LOCAL PLANTS USED TO MAKE JHOLMAL-3

Scientific name	Common name (English)	Parts used
<i>Artemisia vulgaris</i>	Mugwort	Leaves and stem
<i>Justicia adhatoda</i>	Malabar nut	Leaves
<i>Urtica dioica</i>	Stinging nettle	Leaves and stem
<i>Melia azedarach</i>	Persian lilac	Leaves and fruits
<i>Azadirachta indica</i>	Indian lilac	Leaves and fruits
<i>Agave americana</i>	Century plant	Stem and leaves
<i>Chromolaena odorata</i>	Siam weed	Leaves and stem
<i>Lantana camara</i>	Wild sage	Leaves and flower
<i>Prunus persica</i>	Peach	Leaves
<i>Zanthoxylum simulans</i>	Sichuan pepper	Fruit
<i>Tagetes patula</i>	Marigold	Leaves and stem
<i>Sapium insigne</i>	Tallow tree	Leaves
<i>Zingiber officinale</i>	Ginger	Underground rhizome
<i>Allium cepa</i>	Onion	Bulbs
<i>Capsicum annum</i>	Chilli	Fruit
<i>Allium sativum</i>	Garlic	Bulbs
<i>Carica papaya</i>	Papaya	Leaves
<i>Sambucus javanica</i>	Elderberry	Leaves
<i>Acorus calamus</i>	Sweet flag	Leaves and rhizome

Preparation methods

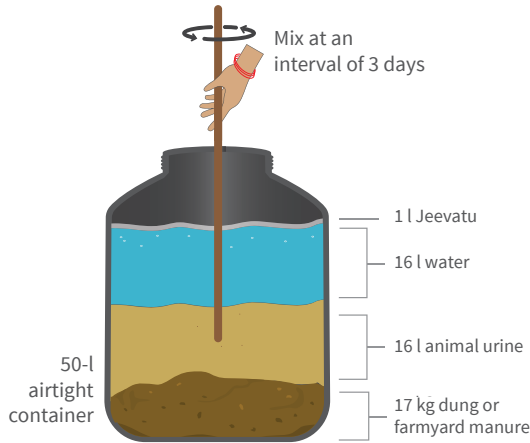
The preparation time for jholmal depends on the temperature; the warmer the ambient air temperature, the shorter the preparation time. Between 15°C and 30°C, Jholmal-1 and Jholmal-2 can be prepared for use within 15 days, whereas Jholmal-3 takes about 21–30 days. At lower

temperatures, the preparation time could lengthen by 5–7 days.

The amount of ingredients to be used is determined on the basis of the capacity of the container. The preparation methods for all three types of jholmal are elaborated in Figure 1.

FIGURE 1 JHOLMAL PREPARATION METHODS

JHOLMAL-1



Preparation time
15 days at 15°C–30°C

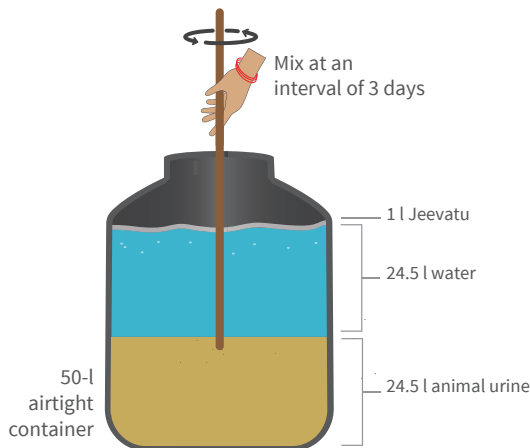


Signs the jholmal is ready to use
The odour of urine disappears and green colour appears at the top of the liquid.



Filtration
Not necessary

JHOLMAL-2



Preparation time
15 days at 15°C – 30°C

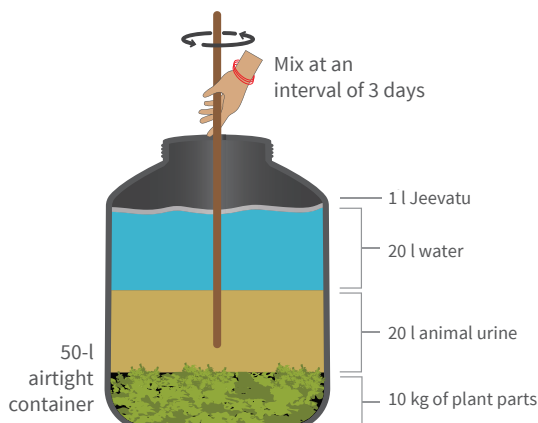


Signs the jholmal is ready to use
The odour of urine disappears and green colour appears at the top of the liquid.



Filtration
Not necessary

JHOLMAL-3



Preparation time
21 to 30 days at 15°C – 30°C



Signs the jholmal is ready to use
There is a strong rotten odour due to decomposition of plants material.



Filtration
Filter the fermented mixture with cotton cloth/sieve to obtain Jholmal-3 in liquid form.

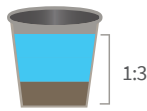
Application

Jholmal is a liquid bio-fertilizer and bio-pesticide, and it is advisable to take precautionary measures and use personal safety gear (gloves, masks, rubber boots) while applying it in agricultural fields.

FIGURE 2 STEPS FOR JHOLMAL APPLICATIONS

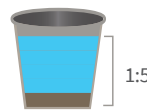
JHOLMAL-1

It provides macro and micronutrients essential for plant growth and development, so it is used as a bio-fertilizer.



For 500 sq. m area:
12 litres of Jholmal-1 is needed

Mix Jholmal-1 and water in a ratio of 1:3



For 500 sq. m area:
8 litres of Jholmal-1 is needed

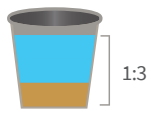
Mix Jholmal-1 and water in a ratio of 1:5



Apply directly on the soil surrounding each plant following the ring irrigation method. The ring should be formed 15 cm away from the main stem base. Apply at an interval of two weeks.

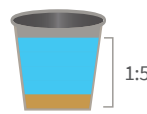
JHOLMAL-2

Its mostly used as a bio-pesticide to control insect/pest infestation in crops.



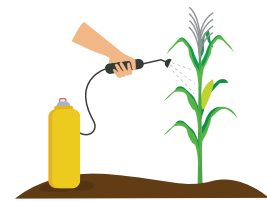
For 500 sq. m area:
8 litres of Jholmal-2 is needed for plants upto 30-60 days old.
12 litres of Jholmal-2 is needed for plants more than 60 days old.

Mix Jholmal-2 and water in a ratio of 1:3



For 500 sq. m area:
4 litres of Jholmal-2 is needed for plants upto 30 days old

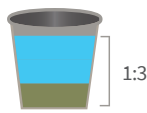
Mix Jholmal-2 and water in a ratio of 1:5



Spray the solution carefully on stems, branches, and both sides of leaves. Apply at interval of once or twice a week based on the severity of insect/pest infestation.

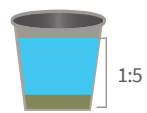
JHOLMAL-3

It is used as a bio-pesticide to control insect/pest infestation in crops.



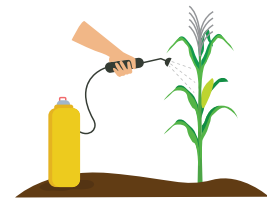
For 500 sq. m area:
8 litres of Jholmal-3 is need for plants upto 30-60 days old.
12 litres of Jholmal-3 is needed for plants more than 60 days old.

Mix Jholmal-3 and water in a ratio of 1:3



For 500 sq. m area:
4 litres of Jholmal-3 is needed for plants upto 30 days old

Mix Jholmal-3 and water in a ratio of 1:5



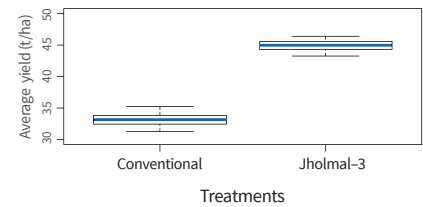
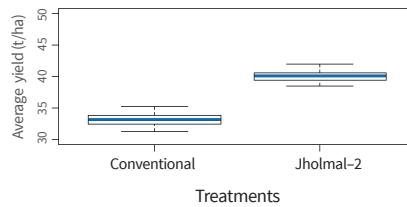
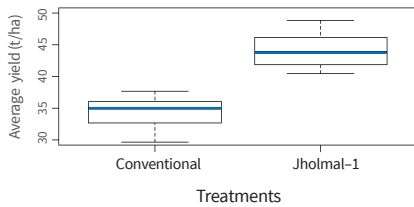
Spray the solution carefully on stems, branches, and both sides of leaves. Apply at an interval of once a week for at least two months or until the insect/pest infestation occurs. In case of severe infestation, apply twice a week.

Efficacy: On-farm evidence from Kavre

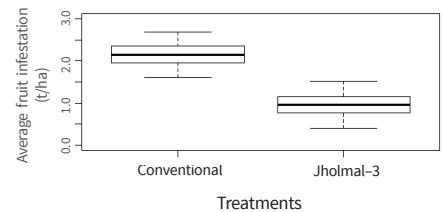
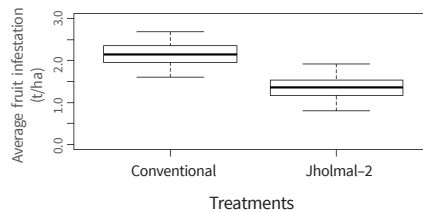
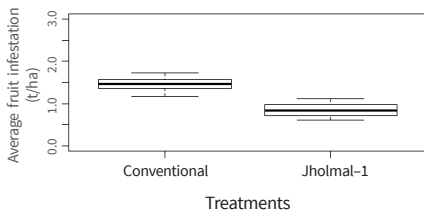
In 2019, the Center for Environmental and Agricultural Policy Research, Extension and Development (CEAPRED) – an ICIMOD partner – conducted on-farm research trials in Kavre District, Nepal, to study the efficacy of jholmal use. The study showed a significant increase in bitter gourd yield compared with the yield obtained through conventional farming practice. Similarly, fruit infestation was higher in conventional practice compared with using Jholmal 1, 2, or 3. For these experiments, Jholmal-1 and water were used in a ratio of 1:3 at an interval of two weeks, whereas Jholmal-2 and Jholmal-3 were used with water in a ratio of 1:3 at an interval of a week. The figures below show increases in yields and reductions in fruit infestations when Jholmal-1, Jholmal-2, and Jholmal-3 were applied compared with conventional practice.



BITTER GOURD YIELD



BITTER GOURD FRUIT INFESTATION



Costs

Collection of animal urine is a must to prepare jholmal. It is therefore important to construct an improved animal shed with a smooth, gently sloping floor to drain the urine into a gutter, which is channelled into a urine collection tank. The shed can be constructed using local materials like wooden planks and red soil or cement. Figure 1 shows a schematic diagram of a medium-sized improved animal shed that can accommodate 3–4 cattle. The urine collection tank is usually constructed near the animal shed and must be covered for protection from direct sunlight and rain.

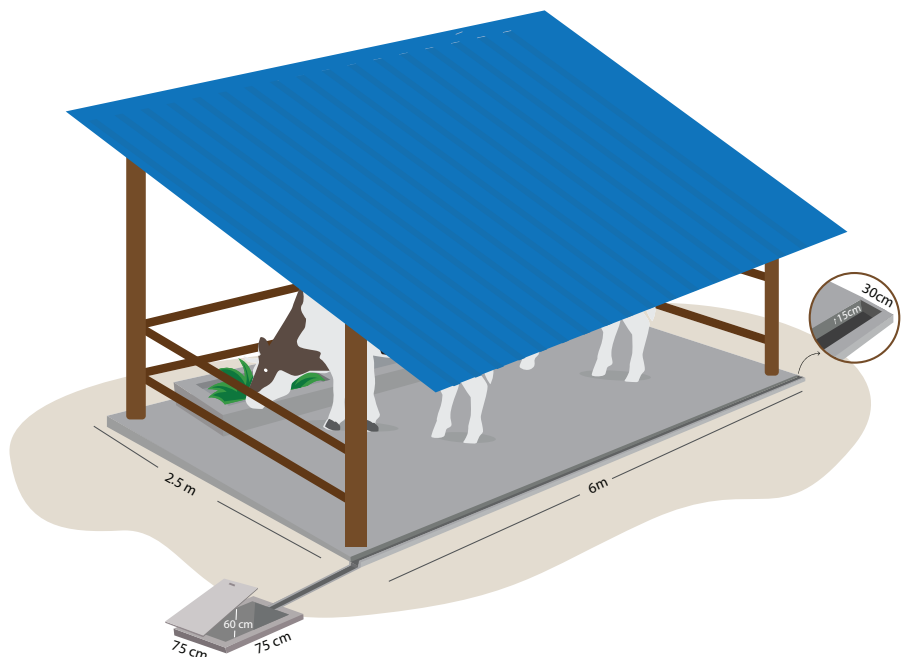


TABLE 2 COST OF IMPROVED MEDIUM-SIZED ANIMAL-SHED CONSTRUCTION

Material costs (NPR)	Labour costs (NPR)
Cement: 7 sacks @ 800 = 5,600	Labour requirement, 3 skilled labourers @ 1,000/day = 3,000
Sand: 24 sacks @ 150 = 3,600	
Pebble stones: 15 sacks @ 150 = 2,250	
Drainage pipes: 10 kg @ 200 = 2,000	
Sub-total = 16,450	Sub-total = 3,000
Total = 19,450	

Note: Additionally, airtight containers (50-l capacity) and Jeevatu™ are required for the preparation of jholmal. (USD 1 ≈ NPR 120 as of July 2020)

TABLE 3 COST OF MATERIALS FOR JHOLMAL PREPARATION

JHOLMAL-1		JHOLMAL-2		JHOLMAL-3	
Materials	Cost (NPR)	Materials	Cost (NPR)	Materials	Cost (NPR)
50-l plastic container	500	50-l plastic container	500	50-l plastic container	500
1 l of Jeevatu™	100	1 l of Jeevatu™	100	1 l of Jeevatu™	100
				Labour cost for collection of locally available plants (0.5 days)	400
Total	600		600		1,000

Note: Other ingredients like animal urine, well-decomposed manure, and plant parts are usually readily available in farms, so the prices for these commodities have not been factored in.

Growing safer food across the Hindu Kush Himalaya

Jholmal is a cost-effective bio-fertilizer and bio-pesticide for smallholder farmers that ensures agricultural sustainability in the long run. It is also a women-friendly solution. As women are usually tasked with the daily management of livestock (including the cleaning of animal sheds), the improvement of animal sheds reduces women's workload. Further, the relatively minimal inputs and simple preparation methods for jholmal lend women more control in farming and financial decisions. It can also be an additional source of income if packaged and promoted in the market. A local agro-vet in Kavre has been procuring, packaging, and selling jholmal since

early 2017 to meet the demand of bio-fertilizers and bio-pesticides from peri-urban and urban areas.

With the demonstrated efficacy of jholmal in the Kavre pilot sites, this nature-based solution has been scaled out in Sindhuli, Sindhupalchowk, Salyan, Dadeldhura, Rasuwa, and Udayapur districts of Nepal and in Haa and Tsirang districts of Bhutan. The Kavre site is being developed by ICIMOD and its partners as a regional learning and knowledge-sharing hub. Several exposure visits have been organized to Kavre for national and international stakeholders to learn about simple and low-cost nature-based solutions. The Government of Nepal has scaled up these technologies and interventions to climate-smart villages in 41 municipalities across the country.

For further information

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