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# Multilayer vegetable farming: Small holder community innovates for improved production

**Written by Prakash Singh , Girish C.S. Negi — last modified Jan 28, 2014 01:59 PM**

**Farmers often try new ideas in their fields and develop many local technologies by innovations and adaptations. These innovations are based on deep knowledge of the local environments, ecologically and environmentally sound. This paper documents such an innovative practice of vegetable cultivation developed by marginal farmers in a mid altitude Himalayan village of the Uttarakhand state in India.**

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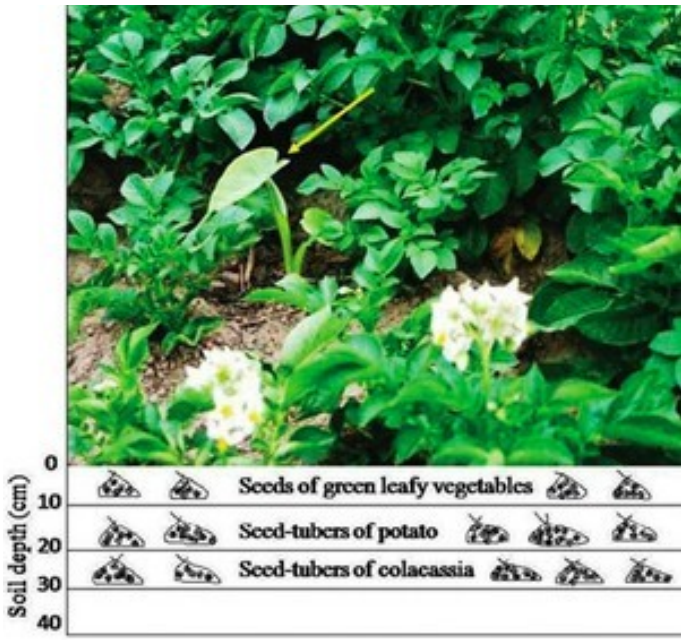
Makrao a small Himalayan village in the Kumaon region of Uttarakhand state of India is situated at an elevation of 1100 meters. There are about 85 households dependent primarily upon agriculture and its allied activities. Around 50 hectares area in the village is under cultivation. Around 90% of the land is rainfed, where crops like finger millet, barnyard millet, paddy, wheat and mustard are grown.

The small patches of irrigated area is under vegetable cultivation. The average size of arable land holding in the village is 0.58 ha. Arable land belonging to migrated families is either cultivated by their relatives or by their neighbors, thus there is no land left unused. The village is well connected with road networks, therefore, has ease in market accessibility and transportation.

## The innovation: multilayer vegetable cultivation

About a century ago, the village elderly persons collectively developed a small piece of agricultural land of about 5 hectares area for vegetable cultivation. While earlier, the land was irrigated through locally developed gools, well-structured water storage tanks and irrigation canals have now been constructed in this land through the help of government departments/ schemes. Initially, vegetables such as carrot, potato, colacasia, green leafy vegetables and spices e.g. spinach, coriander, turmeric, garlic etc. were cultivated in this land as sole plantation.




In lands where colocasia was being grown conventionally as a sole crop, there was no possibility of reaping another crop harvest. The crop duration of colocasia is about 7-8 months, starting from the month of January, each year. Also, the seed tubers of colocasia took 60-80 days to emerge above the ground.

Realising that the top soil layer in the colacasia fields remain unused for a significant period of time due to late germination of the crop, farmers explored ways of utilizing the resources in a better way for improved production.

Farmers first started cultivating short duration green leafy vegetables on the topsoil layer, until the sown crop (i.e. colacasia) germinated and emerged above the ground. Since colacasia is late germinating crop and completes its crop cycle in 7-8 months, farmers made further experiments in the colacasia fields. They shifted colacasia's sowing depth from 10-20 cm to 20-30 cm and made vertical space in the soil for sowing potato simultaneously above the colacasia.

Eventually, farmers came up with a multilayer seed sowing technique in which seeds/seed-tubers of three different vegetable crops i.e. colacasia, potato and green leafy vegetables are now being sown in the deep, middle and top soil layers, respectively and simultaneously in a single crop field. By using this new technique, popularly called as multilayer cultivation, farmers tried to maximize production from an unit area.

Following this improved cultivation practice, farmers first sow colacasia during the month of January in the comparatively large vegetable crop fields. Potato is sown above the colacasia at a soil depth of 10-15 cm and finally in the top soil layer (0- 5 cm) they sow seeds of green leafy vegetables. The top soil layer sown crop (i.e. green leafy vegetables) germinates immediately and is harvested within 20-25 days by the end of February. Immediately, after the harvest of green leafy vegetables, the second layer crop (i.e. potato) emerges above the ground.

It is weeded twice and harvested in May. Subsequent to the harvest of

potato, colacasia emerges on the soil surface and is harvested in October. In the months of November and December the colacasia crop fields are utilized to grow onion saplings, which has a high demand as a winter season planting material in the entire region. In rest of the vegetable crop fields, which are generally small and not cultivated through multilayer seed sowing technique, a diverse range of seasonal vegetables are grown all over the year. The vegetables either sold directly by the farmers in the nearby markets or purchased by a village member who then sells these vegetables in the nearby markets.

Growing three crops in place of one naturally results in competition among crops for water and nutrients. However, in the present case of multilayer farming technique practiced in the Makrao village, both of these competitions are well managed by the farmers. Since, water is drawn from natural spring and stored in cement tanks, there is no scarcity of water for land irrigation even in the summer season. Moreover, farmers (based on a general consensus) have developed a rotational system of land irrigation. In this system, a whole day is allotted to a farmer to irrigate the land using the water stored in the tanks. Through this system, each farmer gets his chance to irrigate the land at regular intervals.

To overcome the problem of nutrient competition in the multilayer crop fields, farmers apply a huge quantity of farmyard manure during the month of December (before sowing seeds/seed tubers of colocasia, potato and green leafy vegetables) in each of such crop field. The land cultivated through multilayer technique is generally close to the farmer's household and therefore there is no difficulty in manuring these crop fields. Most importantly, the availability of enough water and farmyard manure has made this multilayer farming system viable in the Makrao village.

As three vegetable crops are now being cultivated simultaneously, the new technique has resulted in increased production of vegetables per unit of land in the colacasia fields. The input-output ratio (in terms of money) of this system was computed to 1:8, which is significantly higher than the inputoutput ratio reported for potato (1:2), tomato (1:5), capsicum (1:2) and pea (1:2) cultivation (as sole plantation) in the other villages of the region.

# Conclusion

Multilayer vegetable cultivation in the Makrao village is an excellent example of judicious utilization of soil and water resources to take full advantage of limited land resources. Also, access to markets has been one of the major drivers of this innovation in farming practice. This village is considered to be one of the ideal villages among the agriculturists in the region. Soil moisture and nutrient dynamics in this vegetable farming technique should be of interest to further investigation.

**Prakash Singh and GCS Negi**
Prakash Singh (Research scholar) and GCS Negi (Scientist 'D') G.B. Pant Institute of Himalayan Environment and Development, Kosi-Katarmal,

Almora, Uttarakhand, India.
Email: dhailaprakash@yahoo.com
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