

Models of *Khadin* improvement

in the western Rajasthan

D Kumar*, M Patidar, S C Meena and A Patidar

ICAR-Central Arid Zone Research Institute (CAZRI), Jodhpur, Rajasthan 342 003

Khadins are a land-use system prevalent in drought prone, rocky catchments and valley plains. They are based on the principle of harvesting rainwater and using this water in saturated land for crop production. It also helps prevent soil deterioration. Khadins are grown for kharif and rabi crops, depending on the amount of water stored in the lower reaches and the level of water in tanks and wells. Sowing is usually done first in the upper reaches, then in the lower reaches as the stored water recedes. Farmers seek drilled wells and bore wells with the help of government authorities wherever the groundwater level is good. Khadins provide consistent income to the farmers every year besides protecting soils from wind and water erosion.

Keywords: *Khadin*, Socio-economic condition, Water management

KHADIN is a land-use system developed centuries ago by Paliwal Brahmins in the Jaisalmer district of western Rajasthan. This system is based on the principle of harvesting rainwater on farmland and subsequent use of this water-saturated land for crop production. It is practised where rocky catchments and valley plains occur in proximity. The runoff from the catchment is stored in the lower valley floor enclosed by an earthen 'bund'. Any surplus passes out through a spillway. The water arrested stands in the *khadin* throughout the monsoon period. It may disappear below the soil by the first week of November, leaving the surface moist. If standing water persists longer, it is discharged through the sluice before sowing. Wheat or chickpeas are then planted. These crops mature without irrigation. The soil in the *khadins* is extremely fertile because of the frequent deposition of fine sediment, while the water that seeps away removes salts. The *khadin* is, therefore, a land-use system that prevents soil deterioration. This system is similar to some irrigation methods used in the middle east and Negev desert. Its main feature

is a very long (100–300 m) earthen embankment built across the lower hill slopes lying below gravelly uplands. The size of the *khadin* is designed on the basis of local rainfall patterns, catchment characteristics and soil type. On average, the cultivated area under each *khadin* is 10–14 ha with an average dam size between 1.2–1.7 m high × 1.0–1.5 m wide and 100–300 m in length, depending upon catchment area and a number of landholdings. Other than improving the socio-economic conditions of desert dwellers, *khadins* also have created a positive impact on the ecology of the region, effectively checking soil erosion and increasing vegetation cover. For efficient agriculture, a minimum of 15:1 ratio of catchment area to crop area is required. A rainfall of 75–100 mm is sufficient to charge the *khadin* soils with sufficient soil moisture content to raise a successful local crop. In the *khadin* area, the collected runoff water percolates into the ground with time, recharging the subsoil. Of the total runoff collected, only 50–60% of the water is utilised. The construction cost of *khadin* can be repaid back within three to five years. As many as 500 big and

small *khadins* in Jaisalmer district are productive, even with 40 mm rainfall. *Khadin* is a catchment area for eastern Rajasthan desert during monsoon which is filled with water and then, later on, the water recedes and crops like wheat are sown in the area and anicut/small door is made to store water in the catchment area. This remaining moisture in the field is sufficient for the growth of the crop. *Khadins* are the best fields for growth in western Rajasthan.

Different models of *khadin* improvement

Horizontal space utilisation for *khadin* improvement: Rocky upper space (also known as *magra*) has no good soil for crop cultivation so this space could be used for cattle rearing or solar plate installation. The boundary could be made of the field shelter belt of silviculture of the trees like Neem/Ber/Khejari etc. It would provide protection to the field from Loo (hot winds) and avoid water depletion. *Khadins* lower reach may be used for crops and vegetable cultivation. Waterlogged areas could be used for the rearing of the fisheries and pearl culture.

Vertical space management model: In this model, silviculture



Traditional *khadins*

fruit Date palm/Anola/Ber are at the top. In the second row in vertical space crops like Bajra/Wheat/Jeera can be grown. In the third space, vegetables are grown. In marginal rocky soil, animals may be kept under fruit trees Date palm/Ber.

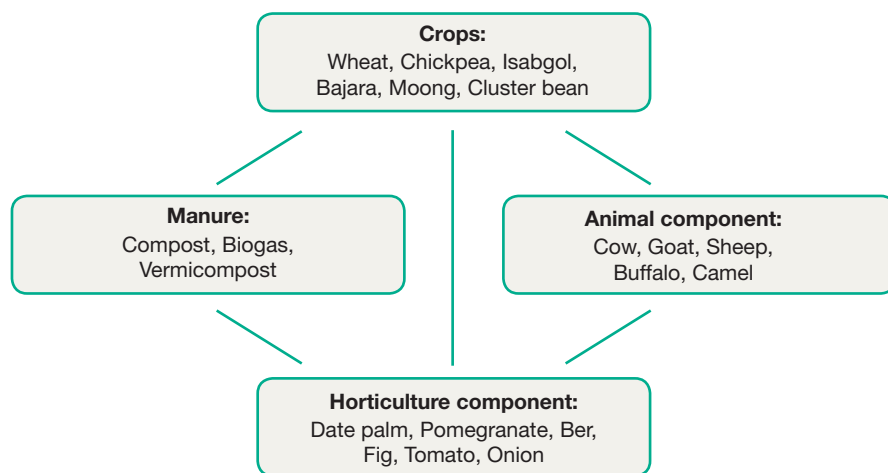
Crop diversification model for Khadin improvement: Productivity of the *khadin* can be further increased by diversifying cropping patterns in the lower and middle reaches and integrating the agri-horticulture system in the upper reach of the *khadin*. Grafted ber (*Ziziphus mauritiana*) and Gonda (*Cordia dichotoma*) are suitable fruit species for the upper reach of the *khadin*. During drought years, mung bean (green gram) and guar (cluster bean) in middle reach and Bajra (pearl millet) in lower reach may be grown successfully. Further, a short-

duration variety of pearl millet can be grown in lowest reaches, even if the rainfall received is 30–40 mm, and soil profiles can be charged with the water of about 200 mm/m in soil. The study further reveals that the HHB-67 variety of pearl millet is suitable for late sowing and can yield grains even if sown up to the first week of September. During a normal monsoon year, the ideal cropping pattern would be Agri Horti (Ber/Gonda + Guar) in the upper reach, mustard in the middle reach and wheat in the lower reach of the *khadin* bed area. There are different methods/models for *khadin* improvement in western Rajasthan. After the assessment of the knowledge level of the farmers about crops, horticulture plants and socioeconomic traits and problems faced by them in the *khadin* system,

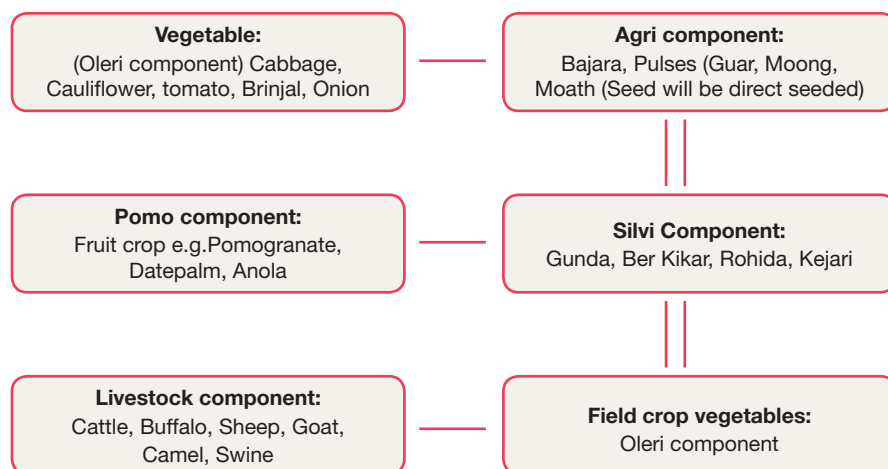
five models have been suggested by the researchers. By adopting these models the production and productivity of these age-old *khadins* can be increased significantly. Moreover, year-round income from the *khadins* is possible with these models as they ensure the organic nature of the *khadins* because the animal component provides organic fertiliser and organic stubbles.

Alternative water use of *khadin* model

Seepage water can be used for crops on the side of bund. Runoff water can be stored in the water tank for cattles. Extra water/runoff water could be used for groundwater recharge, pond making. Surplus water near anicut may be utilized for uplift and irrigation. The pond next to the dam may be used for fish farming and pearl farming.



Integrated Farming System Model for *khadin* improvement



Zero tillage based Agri-Horti-Silvi-Pasture system for *khadin* improvement

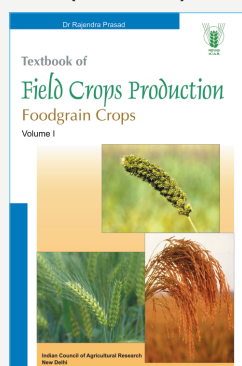
SUMMARY

Khadins aid in groundwater recharging as well as allowing for the growth of *kharif* and *rabi* crops depending on rainfall and runoff. Weather extremes, particularly droughts, have frequently resulted in inadequate food production, leading to starvation and other consequences. As a result, locals used their traditional knowledge to design *khadins* for collecting and storing runoff water from rainstorms, ensuring a steady harvest to support their livelihood. However, knowledge of important aspects such as rainfall intensity and distribution, topography and terrain characteristics, soil type and quality, and people's socioeconomic conditions are required to design an optimum *khadin*. Furthermore, prior to the construction of *khadins*, it is necessary to assess the environmental, ecological and economic ramifications.

*Corresponding author's e-mail:
dkdkdangi@gmail.com

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TECHNICAL SPECIFICATIONS

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