arid land agriculture

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Arid lands of Pakistan are defined as those lands where potential evapo-transpiration exceeds rainfall. Areas receiving a rainfall of less than 100mm to 250mm are called arid, while those receiving a rainfall of over 250mm to less than 500mm are called as semi-arid. These lands constitute about 88 per cent of the country's total geographic area of 79.6 million hectare (mha). Out of this. 40.9mha (51.5 per cent) are arid lands, including 10.5mha of hyper arid sandy deserts and 29.3mha (36.8 per cent) semi-arid.

The whole of the Northern Areas fall in these two categories of aridity. Although 17.99mha have been brought under irrigated agriculture, nearly 52mha of the area still comprises arid and semi-arid lands where arid agriculture is practised. The remaining 5.4 per cent and 6.1 per cent are sub-humid and humid respectively.

Agriculture on these arid and semi-arid lands is mainly dependent on the scanty and erratic rainfall that they receive. Major economic activity consists of livestock production, over grazing of rangelands and growing of dryland crops.

Livestock sector contributes about 30 per cent of agriculture's share to GDP and 94 million head of livestock out of the total national livestock population of 110 million heads is supported by the arid and semi-arid rangelands. These ranges provide 60 to 90 per cent of feed to cattle, sheep, goats and camels, while bovines receive half of their feed from these rangelands.

The dryland wheat contributes 10 per cent of the total national wheat production which is higher than the total wheat production in NWFP or Balochistan and is 67 per cent that of Sindh and 14 per cent that of Punjab which contributes 74 per cent of the total wheat production in the country. Again these dryland areas produce 27 per cent of the national production of maize, 56 per cent of sorghum and millets, 52 per cent of barley, 90 per cent of guar seed, 77 per cent of gram, 89 per cent of pulses, 24 per cent of rape and mustard, 89 per cent of groundnut, 100 per cent of castor bean in addition to drought resistant vegetables and fruits.

In spite of the significant contribution of arid/dry land agriculture to the national economy, greater policy priority was given for the development of irrigated agriculture in the past as dryland agriculture was considered as a high risk enterprise.

Various planned projects for the development of dryland areas could *khushkaba*, *sailaba* and *rod-kohi* (hill torrents).

Rainfed farming system depends entirely on direct incidental rainfall. *Sailaba* farming depends on residual moisture of summer floods and rains in the riverain areas, while *khushkaba* farming is practised in low rainfall areas by catching run-off from uncultivated blocks and diverting it to the bordered cultivated fields. *Rod-kohi* farming system is practised by diverting and spreading the hill torrent water in the piedmont plains.

The estimated average annual rainfall in the country is 180 MAF and 50 per cent of which is lost as run-off. Even if the run-off is taken at 20 per cent, the average annual run-off loss of water comes to 36MAF which is a huge loss and the nation cannot afford it.

The existing conventional water harvesting practices hardly collect 20 to 30 per cent of the rain water, while more modern water harvesting collects over 90 per cent of rain water thus considerably increasing dryland crop production. A wide range of modem technologies are being used in the USA, Australia, Israel, Syria, Turkey, Mexico, India and China for rain water collection and its use for crop production, range improvement, livestock and human consumption in otherwise non productive areas.

For example at Avadat in the Negev Desert, each hectare of cultivated land receives run-off from 20 hectares of uncultivated slope made impervious through chemical and mechanical means in addition to its direct incidental rain. Thus, the cultivated area receives water roughly equal to rainfall of 300 to 500mm from actual rainfall of 100mm. Under this run-off agriculture fair yields of cereals, oilseeds, fruits and forages are obtained. In Arizona in an area receiving 250mm of annual rainfall, water harvesting technology resulting in achieving rainfed crop yields comparable to conventional irrigated crops.

Surface storage may not be feasible everywhere. On high mountains rain water flows to deep streams, nullahs and rivers. This water can be harvested for irrigating the areas along these streams and rivers by lift irrigation by water power driven turbines and hydra-ram pumps

Again, 50 mm of water harvested in addition to the incidental rainfall enabled to increase the yields of rainfed maize, sorghum and millet by 95, 96, and 107 per cent respectively in India where nearly 70 per cent of their total cultivated area is rainfed and contributes about 50 per cent of their total foodgrain production. Similarly the major cultivated area of Mexico and Turkey is rainfed, but their average wheat and maize yields are much higher than that of Pakistan where over 80 per cent of the total cultivated area is irrigated.

not achieve their planned targets due to corruption and mismanagement at various levels. In view of the shattered national economy, burden of foreign loans of nearly 40 billion dollars and expected increase of population to 208 million by the year 2025, the policy makers should plan to get rid of these loans and attain self-sufficiency.

To achieve these objectives all our natural resources will have to be exploited on sound economic bases. Consequently, we must develop our surface, ground and sea water resource base for sweet and saline water irrigated agriculture by the use of latest technology such as construction of new dams and use of sulphurous acid generator and the latest desalination techniques effectively followed in Israel, Saudi Arabia, Persian Gulf, USA. etc. Besides, we must develop our dryland agriculture to its full potential without any further delay.

Of the total cropped area of 22.96mha in the country, 5.14mha is rainfed with another 9.29mha of culturable wasteland, most of which can be brought under rainfed agriculture till irrigated agriculture is extended to these lands. Currently 54 per cent of the cultivated area of NWFP, 50 per cent of FATA, 54 per cent of Sindh, 50 to 60 per cent of Balochistan and 94 per cent of Azad Kashmir is rainfed with much lower yields than their achievable potential. Therefore, keeping in view the major economic activity of dryland agriculture various problem areas are pointed out for the consideration of the policy makers.

About three million people are directly dependent on range resources for grazing their livestock which is suffering from poor health, malnutrition, poor breeding programmes and inefficient marketing system. These issues need immediate attention of the policy makers. Again the depleted rangelands due to over grazing and mismanagement need to be improved by deferred and rotational grazing; control of undesirable species; range reseeding; planting leaf forage trees, shrubs, grasses and following silvi-pastoral system. Various programmes to tackle the aforesaid livestock and range constraints be implemented through community participation approach and monitored effectively to evaluate their impact and timely action to remove any constraint.

As regards the dryland farming, there are four types of crop production systems namely rainfed,

Research studies in arid areas of Balochistan led to increase the yield of dryland wheat by 200 per cent by following catchment based water harvesting technique, suggesting that there is great potential of increasing yields of dryland crops in our arid and semi-arid regions as well as in sub-humid and humid zones by adopting modern water harvesting techniques such as *in situ* and catchment based water harvesting. The national policy makers should take cognizance of this.

Again, there are 14 hill torrent areas with an average annual water conservation potential of 18.6 MAF of water at 1,204 conservation sites. Of which 60 to 70 per cent can be used for the development of a part of 6.35mha of culturable wasteland lying in these hill torrent areas. The highest development potential exists in Balochistan province (7.80 MAF) followed by NWFP (4.5 MAF), Federally Administered Areas (2.8 MAF), Punjab (2.7 MAF) and Sindh (0.78 MAF).

Presently major part of these flows go waste. Major areas for development of hill torrent agriculture are Northern Areas, Azad Kashmir, FATA, Hazara, Kabul, and Bannu areas, DI Khan, DG Khan, Kachi basin, Kirther range, Karachi area and Sehwan and Petaro area hill torrents. The previous conservation structures mostly failed as they were not based on sound engineering principles and this mistake should not be repeated while building new torrent water conservation structures.

Nevertheless surface storage may not be feasible everywhere. On high mountains in the country rain water flows from the mountain slopes to deep streams, nullahs and rivers. This water can be harvested for irrigating the areas along these streams and rivers by lift irrigation by water power driven turbines and hydra-ram pumps. This mountain technology developed by China is very successful for crop production on mountain and hilly areas. A single pump may lift water to over 30 meter height at 60 to 70 litres per second, besides producing 5KW of hydro power.

These pumps do not require electricity or diesel. In uplands and lowlands where such streams or nullahs are not, perennial, there the water may be lifted and stored in tanks or ponds during rainy or short flood seasons and used as supplemental irrigation during the closing of post-monsoon season for increasing the yield of rainfed crops.