AGRO-509

## Causes of Aridity, and Geography of the World's Deserts

Study a physical map of the world, thirty degrees on either side of the equator, you will see, a brown band of drylands circling the planet: the deserts of the world. They lie in the so-called Horse Latitudes, where constant high-pressure systems drive away the rain clouds, and swirl above the earth and the Coriolis Effect (Turn of the wind to the right in the Northern Hemisphere and to the left in the southern Hemisphere) produced by the earth's rotation in space.

### Causes of Aridity

1. **Atmospheric high-pressure zones (Hadley Cells)**

→ Earth's atmosphere moves in general, somewhat predictable patterns that are largely driven by the sun's rays and the earth's rotation. ii) At the Equator, the sun's rays are perpendicular with the Earth's surface; solar heating is intense. Air is heated at the equator, ascends, and is replaced by inrushing air. As the heated air moves upward, it is gradually cooled. Cool air, with a lower saturation point, is capable of holding less moisture within than warm air. **(Equatorial air is very moist).** ii) Oceans cover most of the equator and the high equatorial surface temperature allows large amounts of water to evaporate. So it is not simply warm air that rises at the equator; it is warm, ***moist*** air. As the warm moist air cools, it releases the excess moisture it contains, helping to produce the moist tropics.

i. As the air rises, it cools; the water condenses and precipitation is common. Water returns to the surface as rain.

ii. Deserts do not occur near the Equator, tropics occur there.

Higher in the atmosphere, the now **cold, dry air** rises and moves away from the equator.

At about 30 degree latitudes in both hemispheres (north and south), the air descends (come down) and it warms. As it warms, the air expands, condensation and precipitation **are infrequent**. To the north and south of these desert latitudes, the air once again ascends, producing moisture for the land; finally, over the poles, the air descends again.

Desert formation in these particular latitudes is primarily due to complex global air-circulation patterns caused by:

I. the rotation of the earth on its axis (earth moves at great speed near the equator and slowly near the poles).

II. the seasonal tilting of the earth in relation to the sun, and other factors.

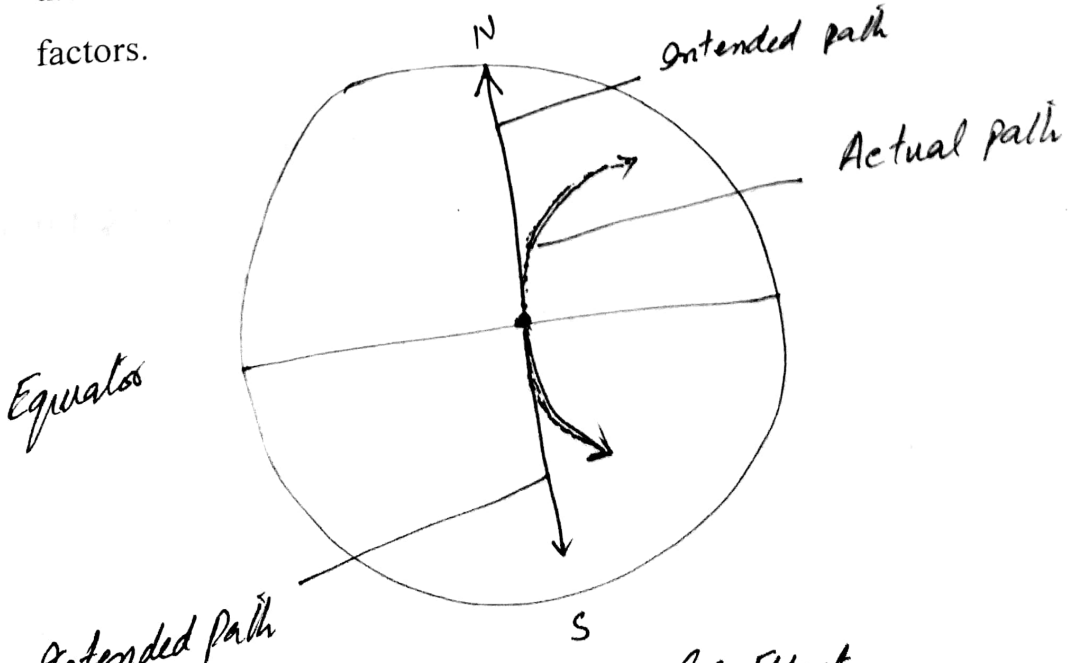


Fig:- Deflection by Coriolis Effect

2. **Continentality or (Distance from oceans)**

a. Most water in atmosphere is evaporated from the sea, and this water eventually precipitates on land.

b. Land closer to the sea generally receives much of this moisture.

c. As air moves inland, it gets depleted of moisture and precipitation drops.

d. Areas lying deep within a continent may become desert simply because air currents reaching them have already traversed vast land distances; by the time they arrive over the deserts, these currents have already lost the moisture they once carried.

e. This is true of some of the Asian deserts., the Gobi and Takla-Makan Deserts.

**3- Coastal Cooling:** Deserts may result if air is cooled, and then rewarmed, prior to reaching the region.

a. Cool air holds less moisture than warm air.

b. When warm, moist air is cooled, excess water condenses and falls as precipitation. If it is subsequently re-warmed, it will be drier than it was previously.

1. Air at 30 C (86 F) can hold 30.4 grams of water per cubic meter ($m^3$).

2. If saturated air (100% relative humidity) was cooled from 30 C to 10 C (50 F), 21 grams of water would condense and precipitate because this cold can only hold 9.4 grams of water per cubic meter.

3. If the air were then re-warmed to 30 C, it would have just a fraction (31%) of the moisture it did originally.
4. 31% relative humidity is fairly dry, and further precipitation is unlikely.
5. Winds that blow onshore tend to do so across cold currents produced by movement of water from high latitudes (poles) to low latitudes (equator), and associated with the upwelling of cold waters from the ocean's depth.
6. Cold or cool winds have relatively small moisture-bearing capacity and, when warmed during their passage over the land, they become stable and, thereby, reinforce the stability produced by the global stability of these latitudes. (Subtropical highs).

c. This occurs along coastal areas where there are cold coastal seas (Baja, California state in Mexico), and in rain shadows.
d. Air moving across the frigid (frosty) currents (Flows) is cooled to a low temperature; thus the air holds little moisture when it arrives over land, where it may provide fog or mist, but rarely rain. (Namib desert in Africa and Atacama desert in Chile).

4. **Rainshadow effects**

(a) Moisture-laden air encounters a mountain mass and is moved upward.

warmer ↑ moisture.
cool — ↓ moisture.

b. The ascending air is cooled and releases moisture on the windward side of the range.

c. The air descends the lee side of the range, warming ~~as it does~~ so, and hence increasing its evaporative power.

d. The windward side of a range may support a heavy well-watered forest, while the leeward side and the area far below it, robbed of moisture, is occupied by a desert or steppe plant community.

The rain-shadow effect produced by great mountains can create arid areas in the lee of the mountains even when continentality is not particularly marked, such as in Patagonia where the Western Ghats and the Andes intercede. Rainshadows include adiabatic heating and cooling.

All climatic, desert-producing factors such as descending, drying air currents; mountain-produced rainshadows; distance from oceanic moisture sources; and cold ocean currents are primary forces producing arid lands.