C. KEY IDEAS FOR FARMING'S CHANGING TIMES

REGENERATIVE AGRICULTURE	"Regenerative Agriculture is a system of farming principles and practices that increases biodiversity, enriches soils, improves watersheds, and enhances ecosystem services. It aims to capture carbon in soil and aboveground biomass, reversing current global trends of atmospheric accumulation. At the same time, it offers increased yields, resilience to climate instability, and higher health and vitality for farming and ranching communities. The system draws from decades of scientific and applied research by the global communities of organic farming, agroecology, Holistic Management, and agroforestry." Source - www.regenerativeagriculturedefinition.com A guiding principle is that over time the levels of soil carbon / organic matter must increase.
ORGANIC FARMING	Organic farming principles are committed to working in harmony with nature rather than against nature. Organic farming works within the natural confines of the farming eco-system. In practice organic farming; avoids the use of chemical fertilisers and pesticides, requires the highest standards of animal welfare, does not permit the use of genetically modified organisms and protects biodiversity by maintaining suitable habitats for plants, animals and wildlife. Organic farming in Ireland is the one system of farming which is fully certified and regulated. Source - Irish Organic Association [abridged version]. NB. 'organic' is a regulated and governed framework whereas 'regenerative' is a system of principles which can be interpreted for individual farms as per the individual farm situation.
ROTATIONAL HERBAL LEYS	Rotational leys were of rising importance in the first half of the 20th Century. They were key to maintaining soil health and fertility and food security in times of population growth. *Ley farming's* rise was curtailed by the availability of artificial fertilizers. Thankfully, as the impacts of relying on such become obvious, a kernel of ley-farming knowledge remains. As the name suggests, they are herbal leys, often established for around four-years, grown within an arable-crop rotation. They provide a valuable disease and weed break in such. To precis Cotswold Seeds, "legumes are the engine room of the herbal ley… these are the plants that provide free N that makes plants grow. [The herbal ley provides] natural mineral rich feeds [by including plants capable of 'mining' the minerals from the soils]. [The] deep rooting plants in a herbal lay will penetrate further down into the soil to draw moisture to provide grazing through dry months… Anthelmintic plants – chicory, sainfoin and birdsfoot trefoil… provide alternative solutions to control parasites in livestock… More deep rooting leys, more carbon capture and better farming… the greater diversity of plants… the greater the diversity of soil biology, which in turn produces greater yield and more carbon capture. https://www.cotswoldseeds.com/downloads/herbal%20leys%20guide%20website.pdf
MULTI-SPECIES PASTURES	A wide plant biodiversity is becoming seen as crucial for the health of soil life. Plants feed soil organisms and *vice versa*, and soil organisms benefit from having the diversity of foods that different plants supply. It is the same for the grazing animal, a diverse diet is better for their health. The likelihood is that this translates through to the qualities of the end human-consumed product. Again, it is now being recognized that some plants have anthelmintics properties and can help to control internal parasites. Undoubtably, a fully functioning soil food web with plant diversity above it is key to the restoration of lost farmland biodiversity. Further, deep-rooting plants are able to source water and minerals from lower levels and to provide drought resilience. The inclusion of legumes can negate the need for artificial N, thus saving cost and reducing pollution of water and emissions to the air. A mixed sward is more resilient than a single-species sward and persists for longer, thus reducing the need to regularly reseed what may be misnamed as 'permanent pasture'. Less reseeding means less soil disturbance [along with the release of stored carbon from the soil] and/or use of herbicides, thus less soil-biome damage. Ultimately, it means lower costs for the farmer.

SOIL HEALTH AND FERTILITY	Soil fertility is not solely about the N, P and K indices. Soil fertility is about the ability of a fully functional soil system to support plant growth and, hence, animal life. Within nature this was achieved without human interference. The separation of humans [and now often their farmed livestock] from the soils that feed them, thus breaking many natural cycles, means that the use of artificial fertilizers has risen. It was seen as the simple solution. This has, however, come at a cost in terms of pollution and emissions, biodiversity loss and the breakdown of soil functionality itself. These and fossil-fuel costs and availability [necessary for artificial fertilizers] means that a radical rethink of what is a fertile soil has to happen. Soil health is about its functionality rather than its inherent properties. It is about biology, not physics or chemistry. Soil as a living ecosystem populated by billions of microorganisms has largely been forgotten. These organisms interact with plants to feed the plant and *vice versa*. Instead, **current farming practices feed the plant and not the soil**. It is an approach that has led to a dependency on artificial fertilizers [and with them their nutrient seepage into the air and water]. The plant's role is to use water and sunlight energy to produce carbohydrates that feed soil microorganisms that, in turn, deliver nutrients and minerals to the plant, preferably aided by deep rooting plants that enable access to those minerals found at greater depth in the soil profile. Hence, healthy soil has a symbiotic relationship with plants and plant growth is achieved through 'powering' the microorganisms in the soil.
CARBON SEQUESTRATION	In this instance, carbon sequestration is about the removal of atmospheric carbon dioxide and storing it in the soils. It operates as a part of a natural carbon cycle and relies on plant photosynthesis. In the context relevant to Farm2Fork2030, the objective is to increase soil carbon levels, thus securing carbon long term. As it is a part of a farmed carbon cycle, cyclical losses are inevitable within the food production activity itself and when food is harvested. The aim is to operate farming systems that move towards **net** carbon sequestration, thus rebuilding soil carbon levels, improving soil health and enhancing soil water management.
INTENSIVE USE OF COVER CROPPING	Cover crops are now common place but their use is evolving. They are about reducing the soils exposure to erosion, 'mopping up' surplus nitrogen in the soil for later use, adding organic matter as a 'green manure', improving soil structure with deeper-rooting crops, and/ or weed suppression. The fact that incentives are being paid to farmers to sow cover crops shows how they are still seen as a net cost and not a net benefit to the cropping system. Regenerative agricultural is now looking at cover crops rather differently. The philosophy is that plant growth [aka all crop production] is driven by photosynthesis and the plants ability to capture carbon. The plant then exudes this as carbohydrates to microorganisms within the soil which exchange the exudates for minerals and nutrients for plant growth. It is an approach that **places carbon at the centre of farm management thinking**. The role of the cover crop, and preferably a diverse species crop, is to maximise the opportunities for carbon capture. No cover crop, no photosynthesis and no plants to feed the soil biology [aka maintaining soil health]. Legume inclusion in a crop mix allows free nitrogen harvesting from the atmosphere. Far from being a cost, maximising the cover crop use to feed the soil is becoming seen as key to a farming system that is less dependent on artificial fertilizers.
TALL GRASS / MOB GRAZING	Tall-grass grazing [aka mob-grazing or adaptive multi-paddock grazing]. The concept has its origins in the ways wild herds grazed grasslands. It operates by grazing high numbers [the mob] on a relatively small area for a short period of time. The high-grazing intensity stops animals selectively grazing. The areas are back-fenced to stop animals returning to grazed areas. The swards are diverse and tall and allowed very long, recovery period after grazing. The system is well suited to grazing rotational leys. The mixed sward of grasses, legumes and herbs is allowed to grow to a far greater height than 'conventional' ryegrass swards ['tall grass']. The residuals left are significantly different. Only the most nutritious, top-third is grazed with the stock encouraged to trample the residual to feed the organisms living below ground. It is about soil health, natural fertility and minimizing purchased input costs. There is a misconception that TGG uses very high stocking rates. 'Spot rates' may be very high for very short periods but they are infrequent events. The seasonal average is not high.

CONSERVATION AGRICULTURE	A set of soil management practices that minimizes the disruption of soil life and structure. Through adopting certain practices, the overall aim is to reduce soil erosion, improve water retention and reduce soil carbon loss. Tillage is now being recognized as a primary driver behind the loss of soil carbon; an issue that is centuries old. That carbon is now to be found in the atmosphere. Tillage is now seen as highly destructive to soil-biome health and it halts soil functionality. A consequence is crop production's dependency on artificial fertilizers. Conservation Agriculture requires minimal soil disturbance through using no-till seeding methods. This enhances the numbers of soil organisms and increases their activity. It also reduces soil compaction and improves water infiltration. It requires permanent soil cover from crop residuals, especially planted cover crops [including N-fixing legumes] or the swift replanting of cash crops. It requires crop rotations to control weeds, pests and diseases. As with *Regenerative Agriculture*, *Conservation Agriculture* is more holistic than 'min-till'. A significant difference, albeit one that will disappear, is the emphasis in the former of using what is described by some as 'biological primers'. They are diverse species cover crops sown expressly to maximize the use of photosynthesis to harvest carbon to feed soil life. Their role is to maximise the presence of LIVING ROOTS in the soil [to feed soil organisms] at all times.
AGROFORESTRY	*Agroforestry* operates by integrating trees and shrub plants into a farmed environment. It does not refer to trees alone and it includes the utilization of hedgerows for food crops and for shelter and stock-grazing. Typically, agroforestry was found integrated with low-intensity livestock farming [including forest and orchard-grazing] but it is now increasingly varied. Agroforestry is now found on arable land where trees are integrated with arable 'alley' crops. The trees are usually grown in wide-spaced rows, and managed as shelter-breaks, for their timber and/or for fruit production. The agro-forestry rows can provide havens for beneficial insects while the alleys may be wide enough for machinery including combine harvesters. Utilizing agroforestry to sequester and store carbon will become increasingly important. *Silvopastoralism* refers to a particular agro-forestry practice that involves pasture-grazing within a partially wooded environment. Forage may be collected, including 'tree-hay', and the trees themselves managed as a timber resource, and as sources of fruits and nuts.
HIGH-NATURE-VALUE FARMING	High-Nature-Value [HNV] farming refers to farming systems operating upon lands that carry a particularly high and important [bio]diversity of flora and fauna. Thus, HNV landscapes, include ecologically valuable habitats. Often, HNV farming is characterized by the extensive animal farming on permanent, possibly wooded pastures. HNV farmland may be semi-natural but with imposed features like dry-stone walls and hedgerows. The farmed land may also include traditional hay meadows and orchards. It may be integrated with some low-input arable farming. HNV farming is often to be found in localities classified as areas with natural constraints [ANC's]. Increasingly such constraints are mitigated by focusing upon creating high-value food products, managing the land for biodiversity and landscape preservation, and operating agro-tourism ventures. In upland river catchments, protecting water quality and flood prevention are increasingly important, as is HNV lands' role in carbon storage.
THE SOIL FOOD WEB [SFW]	Last but not least, the driver of all the natural systems on the Planet, the Soil Food Web. The SFW is the vast biodiversity of organisms that live all / part of their lives in the soil. They range in size from bacteria to earthworms, to insects, to small animals and birds. **It includes plants**. SFW organisms are responsible for the cycling of nutrients, sourced by plants from the atmosphere, stored in soil as organic matter and returned to plants as 'building blocks'. SFW organisms decompose manures and plant residues for storage as soil organic matter. In their turn, deep-rooting plants supplement atmospheric nutrient sources by extracting others from deep in the soil strata. Crucially for farmland biodiversity, SFW organisms are a part of and/or underpin its food supply. ***Humans are a part of farmland's biodiversity.***