Less Food for More People

LOS Banos, Philippines — Agricultural scientists are grappling with a Malthusian dilemma : the Third World's population is growing faster than its food production and no new breakthrough is expected any time soon to dramatically boost harvests.

The planet's human population crossed the 5.4 billion mark last month. And according to the State of the World Population Report of the United Nations Population fund (UNFPA) it will reach 8.5 billion by the year 2025 — nearly 40 million more than previous estimates.

But land planted to major cereals has not increased since the mid-1970's and scientists say yield have plateaued off as improved seeds reach their technological limits.

In addition, the dumping of surplus grain by industrialised countries has artificially depressed international prices of cereals like rice, giving Third World countries no incentives to increase domestic harvests.

Amidst the lush experimental paddy fields of the International Rice Research Institute (IRRI) in this town 60 km south of the Philippine capital, scientists are racing against time to design new rice hybrids before it is too late.

Of the eight billion people the earth will have in 30 years' time, 4.3 billion will be rice-eaters — most of them in Asia.

The world's rice production must rise from 470 million tonnes to 760 million tonnes

Scientists are racing against time to design new rice hybrids that would enable food production to keep pace with population growth. Kunda Dixit of IPS reports.

just to maintain current inadequate nutrition levels, says Dr Klaus Lampe, IRRI director general.

That is an increase of 60 percent. But IRRI scientists say that even with the best existing seed varieties, rice production under optimum conditions will go up by only 30 per cent by the year 2000.

They are testing new rice hybrids that can better withstand pests and adverse weather. IRRI's rice breeders are also using new gene splicing techniques to develop a variety of 'super rice' that can double present harvest levels to 15 tonnes per hectare.

IRRI's sister institutions under the Washington-based Consultative Group on International Agricultural Research (CGIAR) specialise in other cereals like wheat and maize and are desperately testing similar techniques to improve yields.

In Asia, the arithmetic of food production vs population growth just does not add up. Two-thirds of the world's population lives in Asia. But land planted to rice has shrunk, and Asia may fall short by 50 million tonnes of meeting its requirements by the year 2000.

The last time the spectre of famine loomed in Asia was in the mid-1960s when demographers predicted that there was no way food production could keep pace with the population explosion.

But IRRI's miracle dwarf rice and improved wheat seeds developed at the International Maize and Wheat Improvement Centre (CIMMYT) in Mexico brought dramatic harvests in the nick of time.

Between 1964 and 1986, the Green Revolution increased rice harvests in South and South-east Asia by 88 per cent. This despite a 61 per cent increase in population and increase by only 16 per cent of land planted to rice.

IRRI's legendary IR-8 rice made Indonesia and the Philippines self-sufficient in rice. Declared a "basket case" 20 years earlier, India was supplying rice and wheat to famine-stricken countries of Africa by 1985.

While hoping for similar breakthroughs, IRRI scientists admit that this time yield increases have tapered off and rice harvests are reaching their technological limits.

The green revolution also spawned environmental problems. Rise in irrigated land has caused soil salinity. IRRI's new seeds needed to be pampered by expensive fertilisers and pesticides which pauperised some farmers and contaminated ground water and reservoirs.

The green revolution also widened economic disparities within countries. In mostly benefited big farmers in fertile, irrigated lowland farms, leaving small-scale peasants high and dry.

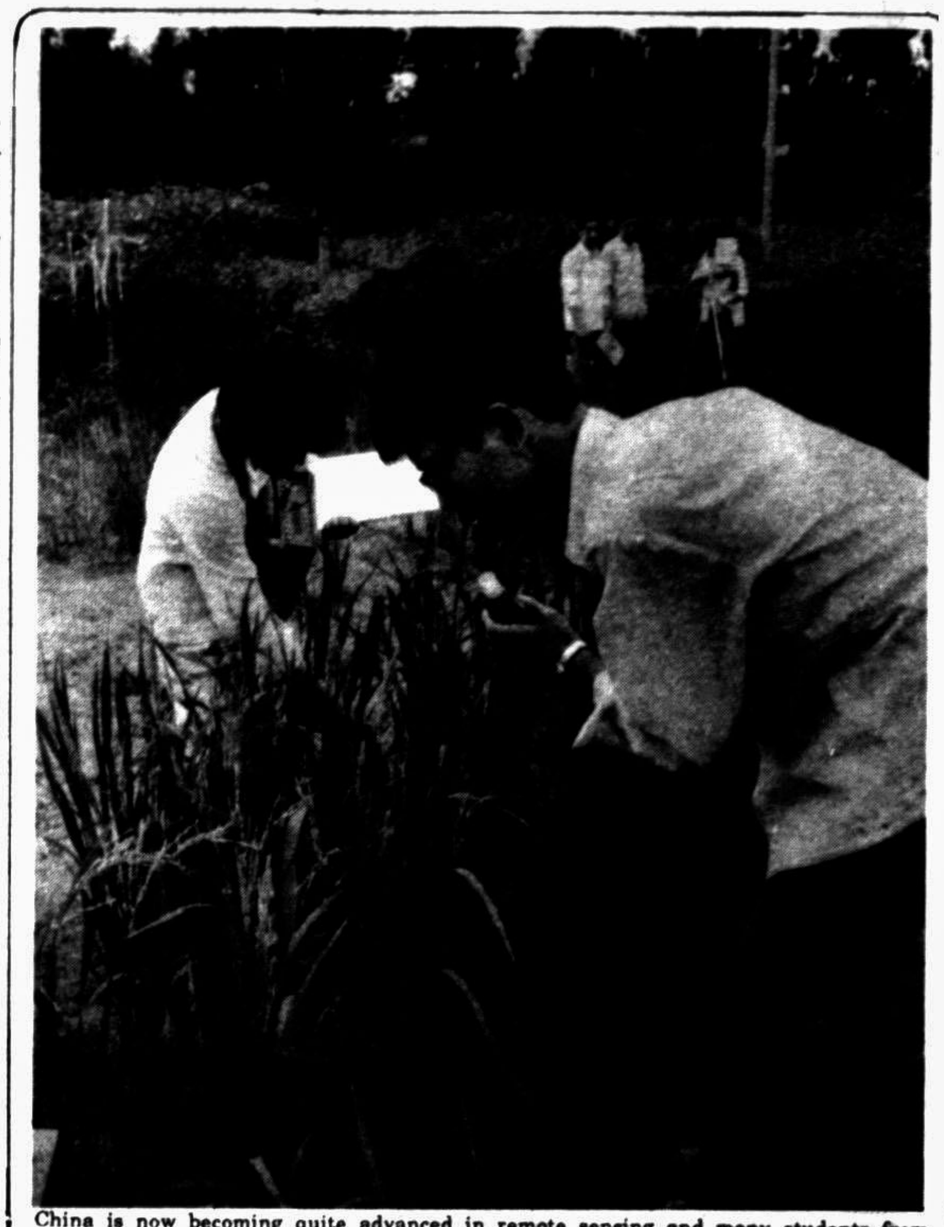
Robert F. Chandler, one of IRRI's founders and recipient of the 1988 World Food Prize, says : "The world can feed itself one decade from now only with massive expenditures unequaled in the past, except in times of war."

Money is trickling in, but it is not quite nearly enough. The US Rockefeller Foundation has been giving seven million dollars a year for the past four year to genetically design a 'super rice'.

The United Nations Development Programme (UNDP) and the World Bank are funding the International Network for Genetic Evaluation of Rice (Inger) to develop high-yield rice seeds.

Stung by past criticism that its new rice has only benefited rich farmers, IRRI is turning its attention to poor upland rain-fed rice farmers, crop rotation, natural fertilisers and pest control.

But experts life Chandler see hope only if population growth can be curbed. "Progress will be slow and difficult until human population growth is substantially reduced," he says.



China is now becoming quite advanced in remote sensing and many students from developing countries come to study at the FAO-assisted research centre in Beijing. Photo : FAO

SCIENCE BRIEFS

Intraocular Lenses to be Made in India

Intraocular lenses for insertion into eyes after cataract surgery will soon be made in the country. As of today, these lenses are imported by India.

Cataract is a condition where the natural lens in the eye loses its transparency. Contrary to the idea of it being associated with aging, it can occur among the youth, children and even in new-borns. The causes can be either congenital, accidental or indiscriminate use of drugs. The result is blurred vision or total blindness.

Cataract surgery removes the opaque lens and vision is restored after wearing glasses or contact lenses of a focal length equal to that of the natural lens. However, accommodation (the natural capacity to focus near and far objects at will) is lost, peripheral vision is affected and objects appear larger than normal.

If cataract has affected only one eye, there is sometimes the problem of double vision. Aged persons are able to manage with these handicaps due to their limited activity, but for small children and youth it is a serious handicap that affects their career.

Contact lenses are inconvenient for elderly people and children as they need very careful handling. Unhygienic conditions and dust-laden air cause eye infections while they tend to fall off in a strong gusty wind. They are also very expensive.

The new lens implant technique provides for a permanent replacement of the affected lens by an artificial lens made of plastic, silicon or glass after a surgery which takes about half an hour. The cost today ranges from Rs 400 to Rs 3,000. (GVJ)

Portable Engine Oil-Testing Kit

A New Delhi-based engineering group has developed a portable engine oil-testing kit that is said to be easy to operate and suitable for on-site applications.

Oils used in engines constantly deteriorate through degradation and contamination with fuel combustion byproducts. Testing engine oil will help determine whether the oil is good enough for continued use and also is likely to help check adulteration of oils.

The new testing kit developed by S S Engineering Industries has a specially designed oil pump that can be used to draw oil from the crankcase directly from some other source into a sample bottle.

The kit also has a visage to determine the exact viscosity of the oil, a hydrogauge to determine the water content and a gauge to determine the maximum required total base number of the oil. (GSM)

New Machine to Refine Gold

A Bombay-based goldsmith has, after 12 years of in-depth research, designed a new machine to refine gold ornaments, which causes no waste or risk of air pollution.

The machine is a compact table-top unit with push button control, and assures complete safety while handling corrosive chemicals such as hydrochloric and nitric acids which are widely used for purifying gold.

Further Success in Molecular Biology

PRIVATE lecturer Stefan W. Eber has recently demonstrated with his own research just how efficient molecular biological methods are today. Thanks to the pediatrician from Gottingen and his collaborators, the molecular geneticist Professor J. Prchal, Alabama, USA, as well as the hematology team at the Children's Clinic of the University of Gottingen, a hereditary malformation of the red blood cells has now been explained in full.

Human red blood cells, the erythrocytes, have an unmistakable shape: circular, with a thick edge and — not unlike a rubber raft — both sides are slightly concave in the middle. The red colour can be attributed to the haemoglobin, which binds vital oxygen to itself, thus making the red blood cells its carrier. However, it is not unusual for red blood cells to be congenitally malformed with membrane defects. Experts believe that there are 30,000 victims of this disorder in Germany and that the number of non-affected carriers responsible for the hereditary transmission of this defect might be as many as 700,000 persons.

The most important disorder of this kind was termed hereditary spherocytosis, due to the way in which the red blood cells are misshaped. Instead of being flat like a disc, the malformed erythrocytes are almost spherical. This greatly shortens their life-time and causes the spleen, where the no-longer functional red blood cells are removed, to become considerably enlarged. Affected children suffer growth disorders, and in particularly extreme cases their skulls are deformed. Frequently, survival can only be assured through constant blood transfusions.

As is the case for all human blood cells, the erythrocytes also possess a membrane consisting of fat-like substances, which is subjected to extreme stress in the blood stream. Consequently, this membrane has a "strengthened mesh" consisting of the protein spectrin. The stability of this system is strengthened even more by additional proteins, which project through the membrane like columns and thus bolster the structure of the mesh. However, in the case of hereditary spherocytosis, the mesh is too weak because it does not contain enough spectrin strands.

In the search for possible causes of this malformation, researchers have concentrated on the sufferings of a family from Gottingen entailing severe anaemia and membrane defects. Here, they were dealing with elliptocytosis, which is closely related to hereditary spherocytosis, but leads to the formation of elliptically misshaped red blood cells. This defect, which prevents the "mesh" from closing, has been traced to one of the "components", which make up spectrin. Apparently, in this case a coupling element is lacking.

This is where the search commenced, tracing the coupling defect back to its origins in the genetic material, the chromosomes. Proteins consist of amino acids arranged in a series, whose sequence and configuration determine the future characteristics of the protein.

How the body is to produce its various proteins is set down in the hereditary "genetic code". This information is initially "read" in mirrored code by appropriate messengers and then brought out of the cell nucleus into the cell plasma. Here, this mirrored code serves as the blueprint for the production of the respective protein. If all of the various steps of this complex molecular process are traced, for example, by isolating and identifying the "messengers", labelling them radioactively and returning them to the cell, they then lead the researchers to their "reading site"; research work much more complicated than it might appear.

This is how the researchers succeeded in recognizing a defect at the reading site of the chromosomal genetic factors for "spectrin components": one single alteration in the molecular information — a so-called point mutation — located on the information carrying section causes all subsequent information to be read incorrectly. However, it is precisely the section demonstrating the point mutation, which is responsible for the coupling of spectrin subunits. This is the reason why one of the spectrin components is lacking a coupling point and the corresponding 129 amino acids. The consequence of this for the red blood cells is that the spectrin mesh in the membrane is not sufficiently interlinked.

It becomes permeable, its stability and thus the life expectancy of the erythrocytes themselves is severely decreased. As a result, the cause of a hereditary disorder, which until now had to be accepted as "destiny", has now been completely explained.

Although no cure has yet been found, the chances for one have increased considerably thanks to this discovery by scientists from Gottingen and Alabama. — P.K.

Rust-Preventive Oil

A Delhi-based company has introduced a multipurpose solvent-based rust preventive oil called "Power Top-SB," reports the journal Industrial Products Finder.

The oil has special additives that ensure protection against rusting and specially formulated water-repellant properties, the journal said.

The oil first cleans the superficial deposits of dirt, grease, and loose metal turnings that might be present on the metal surface and trapped in the small cavities and holes.

Three-Dimensional Priniting

A new printing technology revolutionising the way new products are introduced. It uses metals or ceramics to build a part or model in hours from computer-assisted design. instead of weeks, thereby drastically reducing the time taken to market a new product.

Claimed to be the fastest rapid prototyping (RP) system yet developed, three-dimensional or 3D printing is expected to broaden rapid prototyping technology to allow direct, short-run manufacture of durable part and tools.

Only one or two years away from commercialisation, the new printing technology is expected to heap benefits on the automotive, aerospace, medical, electronics and consumer markets.

It uses metals and ceramics to build a model part or tool in hours instead of weeks. A working model of the 3D Printing system has already been developed at the Massachusetts Institute of Technology (MIT), Cambridge, which is looking for commercial partners, according to a report by the Technical Insights Inc. of the United States.

In this technique, scientists first make a computer-aided design (CAD) of the objec to be modelled. A thin layer of metal or ceramic power is then spread in two dimensions to encompass an imaginary 2D cross section of the part.

A computer-guided device similar to an ink-jet printer fuses the particles to conform to the 2D cross section. Successive layers are built in this fashion until the part or tool is complete.

3D Printing is expected to cut down the time and money involved in solid modelling or prototyping of new products to be brought into market, scoring a big hit over traditional prototyping.

Traditional prototyping invoves hand-carving or machining an appropriate materia like wood, clay or wax based on a drawing or blueprint. In many cases, solid modelling can take months and involves tens of thousands of dollars, to say nothing of several mistakes. It often results in the design budget being exceeded and the product introduction being delayed, with designers literally going back to the drawing board if machine shops and manufacturers are not satisfied with the model.

The advent of CAD has succeedd in replacing the drawing board with a computer workstation which can graphically fit the part into its working environment on-screen.

But no matter how sophisticated or easy the CAD programme, the CAD model has to be faithfully duplicated into a solid model. And it is precisely this solid modelling step which continues to remain a bottleneck.

Rapid prototyping systems now allow a CAD model to be duplicated exactly in solid material in hours instead of weeks. 3D Printing is a further improvement on these RP systems because of its several ingrained advantages,.

It reduces the time to market the product, helps build complex shapes without human error and can make complex models of any size in ceramic or metal.

It eliminates the expenses of multiple machine tools and unnecessary, costly inventory and does away with several steps in die and mold making. Experts estimate that at least six steps may be eliminated when compared to conventional casing.

Most rapid prototyping systems use laser beams to cure a loquid resin to produce a prototype. Laseres are expensive and have a finite optimum operating life. These laser-based systems produce plastic models which are not suitable for prototyping high-temperature or high-stress parts that require metal or ceramic models.

Unlike the laser-based rapid prototyping systems, 3D Printing uses an inkjet printer which makes the operation simpler and cheaper. It also enables ceramic or metal models to be made in exactly the same time as the rapid prototyping systems. Upto seveal hundred finished and functional parts can be made and tested quickly from molds, eliminating several costly steps.

The major attraction with with 3D Printing is that it is not just large companies that will benefit from the new technology. Any company that produces a new technology. Any company that produces a new product design involving a structural part, case, support die etc can take advantage of it.

3D Printing will have a major impact on all manufacturing industries where it can replace conventional in-house design and prototyping serivces. Also expected to benefit are typically small firms that perform general design or prototyping for a broad range of clients.

3D Printing components include positioning apparatus, powder distribution mechanism, and a print or binding modulator. The heart of the 3D Printer is the print modulation system which uses a print nozzle.

The liquid binder leaving the nozzle breaks into droplets which are selectively charged and deflected in an electric field. The binder passes through a 0.34-mm cylindrical orifice where it forms the centre conductor of what amounts to a cylindrical capacitor.

As each droplet breaks off from the stream, its charge is controlled by switching the voltage on or off. Charged droplets fall out of line and are collected, while uncharged droplets continue on a driect path to the powder material.

The parts of the new system can be fabricated with materials such as aluminium oxide, silica, zirconia, zircon and silican carbide. The binder is colloidal silica suspended in water.

The Massachusetts group is also working on a CAD system that will help a designer at the pencil-system uses the three-dimensinal motion of a designer's hands to develop free form shapes.

3-Draw consists of two hand-held sensing devices which are interfaced to a silican graphics workstation. The sensor in the drawing hand acts like a pencil in three-dimensional space and allows the user to draw lines which are captured as three-dimensional curves.

The second sensor controls the orientation and positionof the object being created in workspace. The display shows a perspective view of the object that is consistent with the line of sight between the disigner and the disigner's hands. — PTI Feature.

Insecticide-cum-Paint

A new paint, which both decorates walls and destroys insects, marks a major breakthrough in paint technology, and is being introduced in India for the first time by a Madras-based unit.

When an insect touches the paint surface, it slowly succumbs to the effect of the insecticide in the paint, leaving behind a totally pest-free home. It is the perfect solution for getting rid of insects from walls, cupboards or any surface that can be painted.

The product is non-toxic and does not give out any offensive odour. The insecticidal properties do not diminish in a short time. It kills ants, fleas, mites, bugs, gnats, wasps, vermin, and woodworm. Lizards soon migrate away for want of their normal food — the insects.

The new paint does not peel, flake or stain and retains its fine finish for a long time. No special preparation of the surface to be painted is necessary. Brick walls, wooden surfaces and cupboards can be covered with it. It is ideal for homes, hotels, hospitals, banks, restaurants and warehouses.

The insecticidal effect lasts for two to three years under normal conditions, and a periodic wash with water rejuvenates it.

Fire and Water Make a Volcano

SOME two decades ago, volcanology discovered water as the decisive factor in volcanic eruptions. A "real" volcano only forms when water mixes with the red-hot rock of the earth's interior. At the very least, fire and water initiate the eruption which, in the extreme case, will eject a column of smoke and ash up to 40 kilometres high. This was demonstrated quite dramatically by the eruption of the volcano Bezymiannly on the Kamachka Peninsula in northeast Asia in 1957, and by the "Laacher See" crater lake in the German Eifel region, which was a volcano 11,000 years ago.

In principle, we can imagine the effect of this combination of fire and water as follows: the earths crust contains pockets of red-hot liquid rock, or magma, which can rise to the surface locally. At some point near the surface, this rising magma penetrates the ground water, causing violent steam explosions. These explosions create a crater, which opens the door to the surface for he magma. The release of pressure causes gas bubbles to form in the fiery mass, which expand ever more rapidly, accelerating the rise of the magma.

This "gas lift" drives the red-hot flow out of the crater with the force of an explosion; the ejection velocity can exceed 0.5 kilometres per second. In the process, the rising gas pulverises the magma to volcanic ash and rock particles, which are shot straight up into the air. Liquid lava flows much later, if at all.

The fact that explosive volcanic eruptions are at least initiated by phreatomagmatic processes, i.e. through the interaction of fire and water, was not discovered until the early Seventies at the "Laacher See" volcano in the Eifel as a result of analyses of the ejected matter, the volcanic ash and bombs. However, there are also purely phreatomagmatic volcanos which exude no lava. Thus, at least in the Eifel, the smaller "craters", the so-called "Maars", have been identified as being purely of phreatomagmatic origin.

This relatively young volcanic region is the field of study in particular for researchers from the Universities of Mainz and Bochum. There, researchers have shown on the basis of numerous volcanos that major eruptions are caused when ground water penetrates a magma blister, or, conversely, when rising magma penetrates strata containing water. The importance of German volcano research and its observations in the Eifel for the explanation of volcanic events was made clear at an international convention in Mainz in 1990. In the course of the convention, a number of researchers reported on the identification of water as a trigger for eruptions.

Thus, the eruption series of the Redoubt Volcano in Alaska, which ended in April, 1990, the formation of the Hrossaborg Volcano in Iceland, the eruption of the Rothenberg Volcano in the eastern Eifel 280,000 and 215,000 years ago, and the mass eruption of so-called Komatite lavas from primaeval magmas in Ontario, Canada more than three thousand million years ago, were all classified as phreatomagmatic. Apparently, these phenomena are no novelty on this planet.

What is new is the attempt to study these phenomena more precisely by means of experiments, something which is, for obvious reasons, not possible in an erupting volcano.

Thus, a research team at the University of Wurzburg under the direction of Professor Volker Lorenz are working on an interesting project which they call the TEE-House, TEE being short for Thermal Explosions Experiment. This TEE-house is made of steel plate; inside, phreatomagmatic mini-explosions are produced by injecting water into a vessel containing about 150 millilitres of boiling "model lava".

This provides the scientists with insights into the "birth" of real volcanos. Just as in a life-size volcano, the model lava is also exuded and solidifies in extremely fine particles, which in part are similar to volcanic ash. This ash consists of small crystals, but mainly of glass — in other worlds, molten material which has cooled rapidly; coarser particles are termed "lapilli".

The approximately 400 experiments carried out to date have shown that, at least in principle, the mixing of magma and water can occur quite "peacefully". When the water hits the boiling rock, it is immediately dispersed into droplets which become surrounded by an insulating envelope of steam and cause no reaction, much as drops of water can roll around for many seconds on a hot stove-top. Only when a shock wave is created, for example when a piece of metal is thrown into the melt, does the lava-water mixture become unstable. It then becomes intensively mixed, resulting in a steam explosion.

A "natural volcano", however, generates such shocks itself, for instance due to the constant tiny earthquakes originating from the magma blister.

The experiments indicate that even relatively small water quantities are sufficient to trigger major explosions. Just one twentieth or one thirtieth part water is enough to cause the eruption of all model lava.

Up to now, the TEE house volcanoes have been "operated" in part with carbonate lavas, which rarely occur in nature and which have a low melting point, and in part with basalt lavas at temperatures of up to 1,700 degrees Celsius.

Astonishingly, fibres similar to rock wool, such as are found in the volcanoes of Hawaii, were also formed. The Hawaiians call these Pele's hair, after the volcano goddess Pele, and the term has entered the technical vocabulary of vulcanologists. — Dr Harald Steinert