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Meeting Hi-Tech need based Transfer of Technology for Agricultural Research in Developing Countries

Moderne Technologie für die landwirtschaftliche Forschung in den Entwicklungsländern

by Peethambaram Jegatheeswaran[1]

1 Introduction

One of the greatest dates in the history of engineering was April 28, 1686, when Newton presented his Principia to Royal Society of London. Three centuries have now elapsed since Newton's Principia. It contained the basic laws of motion together with a clear formulation of engineering concepts we still use today, such as mass, acceleration, and inertia. His greatest contribution is the universal law of gravitation. With this impact science has grown at an incredible speed permeating the life of many. Our scientific horizon has expanded to truly fantastic proportions. On the microscipic scale, elementary particle physics studies processes involving physical dimensions of the order of 10^{-15} cm and times of the order of 10^{-22} sec. On the other hand, cosmology leads us to times of the order of 10^{10} years, the age of the „universe". Science and technology are closer than ever. Among other factors, new biotechnologies, the progress in agricultural science and communication technology have changed our lives in a radical way bringing the continents closer, and transforming the face of the material civilization. In spite of this splendid achievements of practical energy and technical skills, the poverty is rising, killing both mind and body (New Technologies for the Third World, 1986).

1.1 The Need

Integrating and being familiar with advanced science and modern technology is a pre-requisite for a sound foundation for the development of human resources for the continuity of the agricultural research and development, and to improve their economic and social living

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standards. Experience reveals only by being in pace with up-to-date technology we can increase the agricultural productivity. It has its limitations, but not impossible.

However, the industrialized nations are taking every effort to make their contribution not only to alleviate poverty but also to free the growing population in the developing countries from drudgery and hardships (RUNCIMAN, 1952). By establishing this need-based Research Center results are more encouraging and motivating self reliance. Mainly the technical assistance, as distinct from the capital, is long standing and the impact is effective. The mission of this Center is to place the technical resources and achievements of the industrial nation at the service of the less fortunate and the handicaped people in this part of the world, not far from ancient cities Babylon and Mesopotamia (C. 5800–3500 BC).

1.2 The Retrieve

It was civilization cradeled in Euphrates and Tigris vallies rather than that of Rome or Byzantium which conceived much of the old classical tradition and transmitted to Europe the knowledge in mathematics, medicine and other sciences.

Metallurgy to Mathematics developed in Mesoptomians still being applied. Science was not neglected, and in mathematics there was both a decimal and a sexagesimal system. It was from the latter that we get our 60 secondes minute, 60 minutes hour and the division of circle into 360 degrees (The World Reference Encyclopedia, 1987).

Centuries back poverty was unknown in these regions. Since the time of phoeniceans of second millennium B.C, This part of the world has been in the peak of civilization, privileged with the highest form of communication using ancient alphabets. The fundamentals of turbines, the flowing fluid as the driving force, used in the twentieth century turbo-prop and in the nuclear powered stations is not different to that of the sixth century water-wheels „The Nora" of Hama in Syria, the hydro-powered water-lifting system.

There was a sudden stagnation of the engineering application, but the cultural inheritance remained. The rites and beliefs tied to the society by the religious tradition, played a major role, impeding the progress towards science and technology (SCHUMACHER, 1980).

1.3 Arrested Progress

The people who lived for centuries in poverty in the world of their own, have come to terms and compromise with this existence. Many do not strive, generation after generation, century after century, against circumstances that are constituted to defeat them. They accept, conditioned by their own creation of poverty.

In most of the farming community the struggle for economic improvement held to be general. The farmers known to be enterprising people, live in relatively well nourished penury with full acceptance that this was their intended fate „Karma". Because the pain of poverty is denied by religious compulsion, but its compensatory spiritual reward is very high.

Fig. 1: The enterprising domesticated animals. Still being continued with full acceptance that this was their intended "Karma"

The poor pass through the eye of the needle into paradise: the rich remain outside with the camels. Acquiescence is equally urged by the other ancient faiths, or as in the case of Hindus compelled. The outcasted and the poor claimed to be children of God, the desire, subsequently the aspiration to escape poverty is in-activated. In the poor rural community aspiration in turn is in conflict with one of the most profound and predictable elements of human behaviour. A refusal, the motivation to struggle against the impossible, the tendency to prefer acquiescene to frustration. Desires, that motivate, the driving force for development is not encouraged. The contentment urged by religion, designed to lead to acceptance by diverting attention from the realities of class and exploitation, to make the best of a hopeless situation. „Give up your desires to attain nirvana, to free oneself from the eternal cycle of rebirth and death, and to escape the worldly miseries" was preached.

1.4 Reflection on Promises

Still there is hunger in our world of plenty. Population is increasing. Entire world is worried. Question may be put, whether it is a burden: If our own, is not a burden. Who sees a problem and whose problem we want to solve! Realistically seen, the population expansion is a threat only to the less privileged and to the poor. They are at the mercy of the generous-left-overs. About 70% of the world food production is consumed by about 20% of the world population.

30% to be shared by the 80%. The energy consumption in the west is about 200 times more than that consumed by this so called growing population (The World Reference Encyclopedia, 1987).

But, once we begin to feel hunger as real people coping with the most painful human amotions, we can perceive its roots. Certainly it is not scarcity. The world is full of food. According to the statistical data from FAO, the world today produces enough grain to provide every human being in our planet with 3600 calories a day. That is enough to make most of us fat (The World Reference Encyclopedia, 1987).

No country in the world is a hopeless basket case (The World Reference Encyclopedia, 1987). Even countries many people think of as impossibly overcrowded have the resources necessary to free themselves from hunger. Every year hunger kills as many as 18 to 20 million (The World Reference Encyclopedia, 1987). If we think of hunger only as numbers, the solution also appears to us in numbers; numbers of tons of food aid or numbers of dollars in economic assistance for their „Development". Not a solution.

The word development, is often used with one thing in mind – eradication of absolute poverty, hunger and what. But there is no „yard stick" to measure. However, the observers and participants have a general consensus on what it means. *It means modernization by extending the Western world. Not only transfer of technology, but transfer of culture and transfer of civilization.*

Poverty is cruel. An endless struggle and promises to escape that is continuously frustrating, is more cruel. It is more civilized, more intelligent, as well as more plausible, for the people, out of experience of centuries, should reconcile themselves to what has for so long been the inevitable.

1.5 The approach

In April 1972 the Consultive Group on International Agricultural Research (CGIAR), concerned about the state of agricultural research in the Near East and North Africa, commissioned a team to review the research needs of this region.

This mission identified a widening gap between demand and domestic production of grains and livestock, together with a declining productivity of natural resources. To deal adequately with these and other regional problems, the Mission recommended the establishment of a research center for the Near East and North East and North Africa. Center was created in 1978.

Today, ICARDA has grown into a world-center having impact on highly sophisticated scientific research and development, a center of excellence in respect to agricultural productivity based on highly sophisticated scientific research and development, backed by modern technology and skilled man-power. Yet the impact goes beyond just increasing only agricultural productivity. It has other socio-economic spin-offs. The trained man-power is an added value contributed by ICARDA, not only for the regional and national benefit, but also for the benefit of this

Center, which could be felt in the form of its high performance. This of course extended to the other national programs in developing skilled man-power – „The wealth of a nation lies in the skills of its people" – i.e. upon the development and organization of our own man-power and activities.

The objectives of ICARDA are to conduct research and training to increase and stabilize food production in the region and specifically:

- To serve as an international center for research into and the improvement of barley, lentils and broad beans *(Vicia faba)* and such other crops;
- To serve as a regional center as well as to conduct research into and develop, also to collaborate with, and foster cooperation and communication among other national, regional and international institutions in the adaptation, testing and demonstration of improved crops, farming and livestock systems;
- To foster and support training in research and other activities carried out in the furtherance of its objectives.

Within these objectives ICARDA supply the basic inputs and know-how as well as all the facilities for an integrated farm resource development approach to the problems of food production in the region.

2 Man Machine Interface

The only prime mover (a machine generating or, rather, converting energy) available to early man was his own muscle power. The enterprising and the thinking domesticated animals. Indiscriminately all over our planet this was available to every homo sapiens, our thinking, tool making ancestor. Of course, it is a matter of definition whether or not the tools made by the early primates can be called machines. His tools and implements may be regarded as a reinforcement or extension of that muscle power.

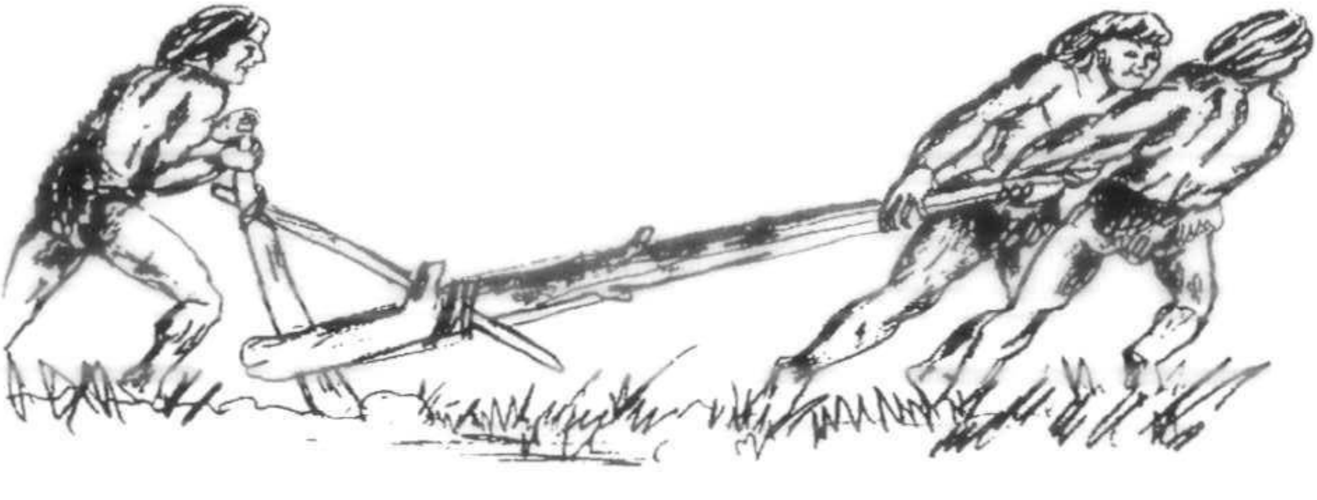

Fig. 2: The only prime mover available to early man was his own muscle (STRANDAH and SIGVAD, 1979).

This combination of hand and muscle power, is a working machine. As defined by a German engineer, Franz REULEAUX (1829–1905): „A machine is a combination of solid bodies, so arranged as to compel the mechanical forces of nature to perform work as a result of certain determinative movements". This technically subtle definition does not really do very much towards the classifying the concept of a machine. Reuleaux's handbook of engineering was published in 1861, and was re-issued in new, revised editions and translated into many languages. In 1875, he published a comprehensive work on the theory of mechanical engineering, Theoretische Kinematik: Grundzüge einer Theorie des Maschinenwesens. During this period no such documentations, no analysis has been observed in the developing countries, though they had access through colonial powers.

This approach to technology may be taken to mean the advancement of our understanding of the way in which the observable world works, the development of logical, integrated and self-consistent descriptions of why and how such and such individual happenings occur, why apples fall from trees, why they are coloured red and green, why they are good to eat, irrespective of the immediate utility of these statements. That is to say, a derivation of the laws of gravity or of optics. Application of these are seen as technologies – they do not add to our understanding to the working of laws of nature, but they add to our control over the world around us. Fig. 3 and 4 illustrate some application of old technologies still being applied.

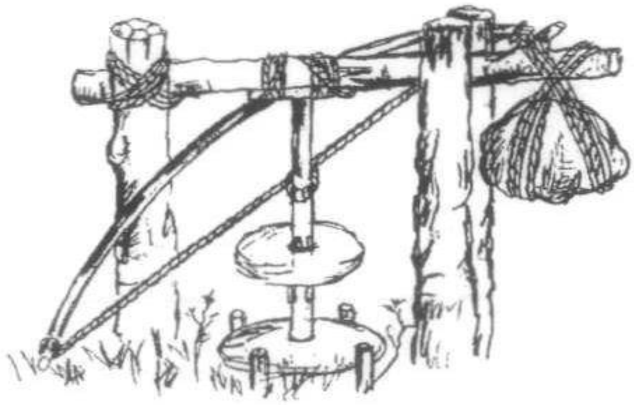

Fig. 3: A Stone „Machine-Tool", to drill hole on object, with drill and flywheel, driven by bow. The counter weight to press the drill (STRANDAH and SIGVAD, 1979)

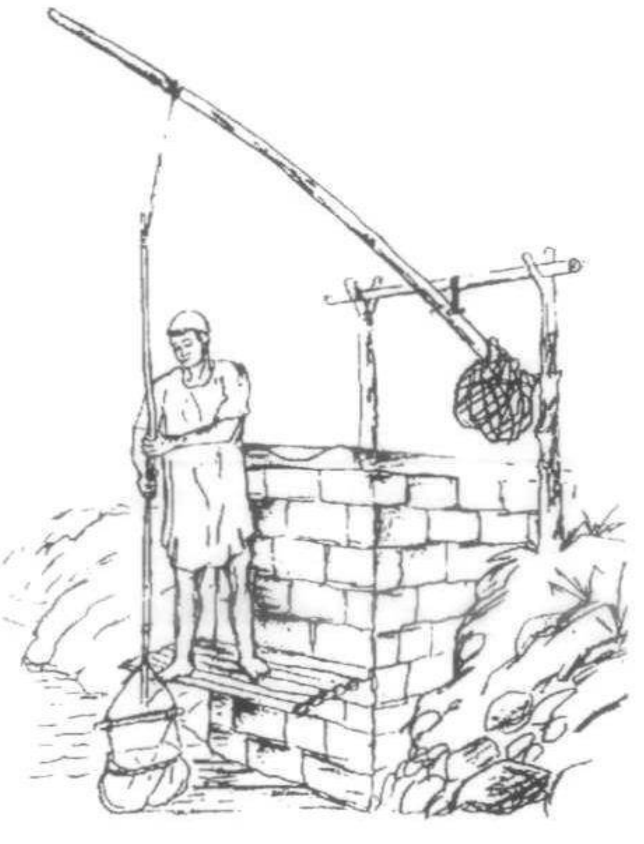

Fig. 4: A shadoof. The counter weight helps him to lift the leather bucket filled with water. Still in use (STRANDAH and SIGVAD, 1979)

Science and technology must be seen as interacting terms; discovery precedes invention, and invention in turn presages discovery. As cavemen, we discovered the fire and the technology to keep us warm and invented the wheel for our transport machine. Today we cannot imagine our day to day life without these components, its usefulness much more conceived by the scientific application. If there is no scientific approach to technology, neither development nor progress could be expected. They will remain isolated by the „outdated" technology (ROSE et al., 1977).

Mechanization or development is a product of motivated reasoning mind and need based thinking. Thought that creates the mind. Since the thought is conditioned by the need as a result of our environment the mind either gets drowned or swims in the thought. The reasoning mind that produces the skills and talents. The intelligence the by-product of these two in varying magnitude has to be cultivated to develop the individual, subsequently goes to the benefit of the society.

Simply dumping of sophisticated farm mechanization can increase neither productivity nor the living standards of the people. Some have lived all along in an environment that is devoid of even the simplest technical items. Some are unable to comprehend even the simplest technical matters without a special orientation program. This may sound as peculiar problem to realize, but it is typical technically-handicapped-country problem, of having to train and develop skilled man-power entirely from available resources-people who are educated, but had been all along been totally unexposed to technical environment. It took centuries for the industrialized countries to reach the present engineering achievements, though depending on resources from the colonial subjects. A planned approach is required to succefully implement integrate and familiarize these countries with modern technology, and the know-how.

2.3 Knowledge

Though the developing countries are blessed with surplus man-power and natural resources, are not in position to harness these for their own benefits. With limitations in man-power and raw material, the industrialized countries are enjoying over-productivity, resulting only from years of efficient management and administration, placing gravity on developing the human skills. Thus, successful development rest on tapping the three basic skills, technical, human and conceptual skills of our man-power.

The lack of know-how is perhaps the root cause of most of the miseries. The knowledgeable survive. As the Chinese proverb says „give him a pound of fish, he can survive. a day! But teach him to catch fish he can live for the rest of his life". Thirst kills the destitutes in the ocean. A simple desalination process, may provide water in abundance. Knowledge is potentially the most egalitarian of all assets. It costs the user little or nothing but requires no credit or foreign exchange, and can be spread to the tiniest small holder as well as to the great fuedal landlord. Yet the transfer of know-how/technology rarely fulfils its immense potential in developing countries.

Agricultural system being practiced in this part of the world many centuries before the western civilization, but the productivity has hardly increased. The rural farmers' yield is much below than that of his counterpart in the western world. Undoubtedly the rural farmer, including the family toil, much harder.

All the new land, all the fertilizer and new seeds in world are of little use if the farmer does not have the facilities, and cannot market the produce. On the other hand, a farmer who can be taught to improve his cultivation practices can often achieve tremendous gains in output at no extra cost beyond a little care and planning and a few extra hour's work supported by the appropriate machine and adequate energy (LAPPE et al., 1988).

Hi-tech man-power is required to promote research and development activities. The widely held notation that hi-tech mechanization may cause surplus labour, is an unreasonable and rash conclusion. Even in developing countries the labour is expensive. But unlike the industrialized nation, a research center in a developing country needs versatile engineers, technicians and mechanics with specialization in adjacent fields.

3 The center and its operation

ICARDA's principal research activities are carried out on a 948 hectar-farm, its headquarters 30 kilometers southwest of Aleppo. The full scope of the Center's activities integrated with cooperative research carried out with many countries of the WANA region (West Asia and North Africa). The major activities are in locations in Syria, Jordan, Quetta in Pakistan, in Morocco, Algeria and Tunisia, and with Egypt, Ethiopia und Sudan in the Nile valley.

3.1 Scope of Activities

In terms of crop research ICARDA has the world mandate for the improvement of barley, lentil and faba bean, and regional responsibility for the improvement of wheat, chickpea and pasture and forage crops.

Not only concentrating on food production ICARDA seeks to improve the social and economic conditions for the people living in these region. It has its commitments towards the local farmers, that will help them to achieve better and more harvest. Where, the dry summer and relative low winter precipitation ranging from 200 to 600 mm demand the labour intensive farming practices, giving way to mechanisation. With the existing traditional systems the results are disappointing and frustrating. ICARDA foresees the need. Soil is a basic resource and for our purposes non-renewable. Many of the soils are self-mulching clays which are plastic when wet, crack extensively when they dry out. Such a surface, untilled and unprotected looses the little water to evaporation, through the cracks and the micropores. The local farmers till constantly between the olive trees, even if they are growing nothing in between. Several technologies have to be adopted to the existing tradition – which cannot be ignored. An example, relationship between stubble retention, zero tillage and moisture storage being constantly studied. In-house single pass planter designed and developed by a team and fabricated for fields trials.

With the increase of population mechanical cultivation being encouraged. Tractors and farm-machines are spreading, and manufactured locally. But needs the integration of modern technology, to improve its performance and effectivity. ICARDA is integrating the advanced technology, and the results are encouraging.

3.2 Human Resources

A major constraint to ICARDA's Research and Development in this region the shortage of skilled man-power, software and hardware to carry forward programs of hi-tech-engineering applications. Priority and emphasis have been given mostly to programs of crop improvement, production technology and others, neglecting the importance of man-power for the engineering research and development. Trend to use advanced technology (electronic, micro-processors, hydro-pneumatic controls, etc.) in most of the tractors and implements and other research and routine equipments, and devices for research and development is common, which demands skilled staff and facilities.

Academical and non-academical, skilled and non-skilled staff are available in abundance, but require technical guidance and engineering oriented management: Guidance in the form of training and participation; management by developing awareness and sense of responsibility in the light of compromise and creativity, to make the best out of the available means.

The strategy is to provide opportunities and extending available facilities in theory of technology and the know-how for technical staff personnel from the center, and extend to those from other regions. On- and off-the-job training program, has a significant impact to assist in providing trained personal. To provide expertise and skilled man-power, to produce equipments and respective components, for the smooth running of this Center, an ultra-modern operation and production workshop is a pre-requisite.

3.3 Operation and production

Adopting engineering management techniques such as operation research and management informations systems involves radical changes in current practices, skills and attitudes. For the effective utilization of the available funds the modern operation research techniques is a major factor in the success of the development project. Operations Research seen as a broad multi-disciplinary problem solving acitivity which is based on the scientific approach. Experience reveals Successful Operation Research work requires a broad approach using a range of qualitative and quantitative skills.

3.3.1 Self-Reliance

Non-availability of local expertise and hardware from local suppliers demand ICARDA to be „Self-Reliance". In view of a need for high quality products the workshop facilities are focused not only for maintenance but also established for production as well as for training:

- Well equipped with machine tool, welding bay, good quality hand-tools and instruments.
- Capacity to design, develop and facilities to fabricate agricultural implements, research devices and equipments, promoting constant improvement and modifications to existing machines and equipments.
- Constant monitoring of work improvement techniques, quality control, stocking of quality material.
- Providing organized training in workshop technology for in-house staff, university students and apprentices.
- Developing awareness by recycling of waste, utilization of solar and wind energy for future practical applications.

On-the-job and off-the-job training for in-house staff, is more convenient and productive rather than employing new. Setting up of such training program neither affect the routine work nor causing additional expenditure. Although the initial purpose of the engineering service for maintenance center's facilities, it is providing unique opportunities and facilities for production as well as for training in the respective field: A major contribution for the development of the human resources, which is within the mandate of ICARDA.

To develop the required self-reliance, a carefully planned pre-training course is being carried out, to bring them up to certain level of awareness, followed by the process of imparting appropriate technical training to them.

In order to effectively develop and tap their potential skill, a catalytic awareness developed as to „what we could offer this center, without asking what ICARDA can offer us". What ICARDA could offer them lies in their contribution. Without this trained man-power a continuous agricultural productivity will not be possible, and research and development may, to great extent, be impeded. It is this same work force, significantly who have contributed to develop ICARDA into a highly sophisticated complex it is today - a mutual reward and contribution.

With available facilities training-systems specially tailored to the requirement of the respective trainees:

- Mechanics, electricians and technicians
- Fitters, welders, turners
- Farm machinery and tractor operators
- Apprentices (university students, in-house staff, beginners)
- Farm management and operation and production management

3.3.2 Design and Production

When confronted with design and fabrication of prototypes the research and development engineer requires a clear train of though and will therefore develop and establish an analysis, utilizing center's facilities for brain-storming whereby the engineers, scientists, users, operators and technicians of the center are brought together, a form of stock taking to obtain the answer to:

- purpose of the product
- method of operation, know-how of operator and maintenance
- method and type of power flow
- Design form and location of operation
- Production producers and cost

However, several other factors also have to be considered concerning to the suitability of the machine. For instance, the design criterion for the production of environmental controlled growth chamber for tissue culture is different to that of an agricultural implement for the local farmer. However during the development of a farm machine following characteristics taken to consideration:

- Make or buy analysis,
- Initial investment cost to be within the means of the local farmer, or at an optimum cost of the project,
- Low cost for maintenance and repairs, availability of spare-parts,
- Simple to operate but with relative high performance,
- Possibility of local manufacture,
- Free the farmer from drudgery and hard work,
- To be used on conventional tractors or if possible with draught animals.
- Utilization of standard and commercially available components.

Designing and developing a simple and efficient machine demands an intensive study of the problem with devotion. Furthermore frequent field trials and modifications had to be carried out, which of course need longer period for obtaining production prototype, than a complicated and expensive machine. Furthermore due to unique seasonal factors field trials, modifications and changes have to be done without delays, which demands skilled efficient staff, and proper planning. Using network analysis has proved as a valuable software tool.

3.3.3 Prototype

Several prototypes and regular equipments, machines and implements have been fabricated: such as straw collectors, lentil harvesting machines, planters, threshers, harvesters, environmental controlled growth chambers and several other research aids and devices. Brief information, description as well as their significant contribution to agricultural research and development of few are reflected here. The design is primarily determined by the engineering function, with support from research in terms of advances in technology, and most efficient for its purpose.

3.3.3.1 Lentil Harvesting Machine

The mechanization of lentil harvest in the Middle East is a major research goal of the food legume improvement program, because lentil areas are declining due to increased labour costs for harvest in comparison to local as well as world lentil prices.

The traditional method of sowing lentils in Syria is by hand broadcasting followed by a cultivator pass to cover the seed leaving a ridged field. Differences between harvest methods and the interactions between harvest and sowing methods are highly significant for both seed and straw yields. The ICARDA's angled blades and lentil puller worked best on the traditional broadcast seed bed. Research and development on lentil harvest mechanization was made possible at ICARDA following a grant from the International Development Research Center of Canada and Gesellschaft für Technische Zusammenarbeit of Germany (GTZ).

Fig. 5: Front-Mounted Angled-Blade Cutter with locally manufactured EBRO-tractor during Lentil Harvesting (IDRC-Project)

The angled-blade cutter has been developed from a conventional bean-harvesting machine, where the bean plant was uprooted. Considering other relevant adverse effects resulting from uprooting the plants, such as soil erosion and depriving the soil fertility by taking organic matter out, the gravity of harvesting is placed on the cutting system (Fig. 5, 6). This was completely designed and fabricated at ICARDA.

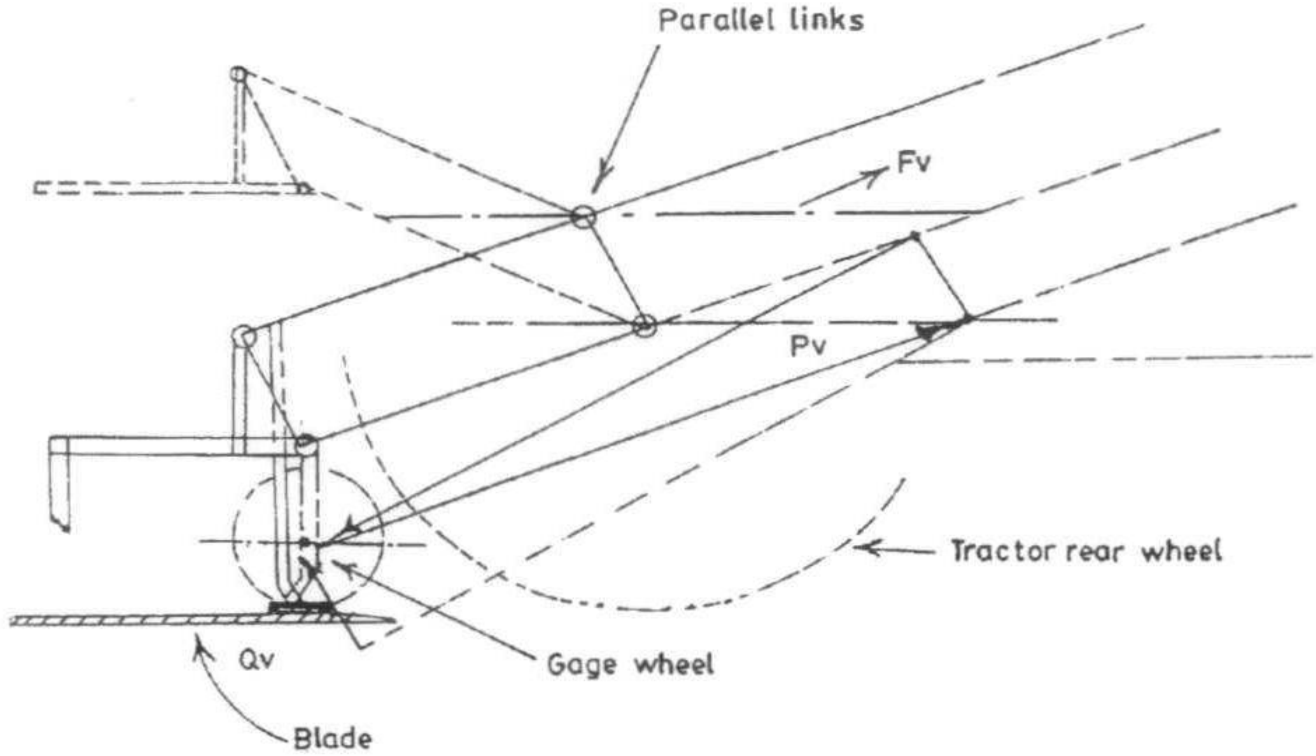

Fig. 6: With this parallellogram system the blades are maintained parallel to the ground. The ground and the blade are the two shearing elements.

The way of cutting is by means of two opposed shearing elements which pass each other with minimum possible clearance. To obtain these two moving elements the angled blade as first moving element is pulled along ground, the second moving element relative to the blade. Thus, in addition to the ground as one of the opposing cutting element, the plant material is strong enough to transmit the opposing force. The blade is guided not more than 1 cm below the ground surface, to obtain an efficient cutting at the same time to maintain soil ratio as low as possible in cut-plant-material.

Based on several field tests during three seasons the final prototype was fabricated, as shown in Fig. 6. The shanks carrying the blades mounted to individual parallelogram frame, and kept in tension in the direction of travel by a spiral spring. The tension of spring kept proportional to the cutting depth of 1 cm. The shank, the blade, the spring and the frame as individual unit mounted on to the main frame. The main frame, 3-point link system hitched to the tractor where the two lower arms and the upperlink forms a parallelogram. With these combinations, the blades kept parallel to the ground and at constant depth of 1 cm.

The front-mounted prototype (Fig. 7) is released to be used by the local farmers, to be easily fabricated locally at a realtive low cost. The lentil puller has a rotating header driven by the tractor-powered hydraulic motor. During the forward movement the plant is caught between the header and the built in conveyor belt, up-rooted and sucked into the trailer. Other than regular setting and adjustment neither special care nor special tools required.

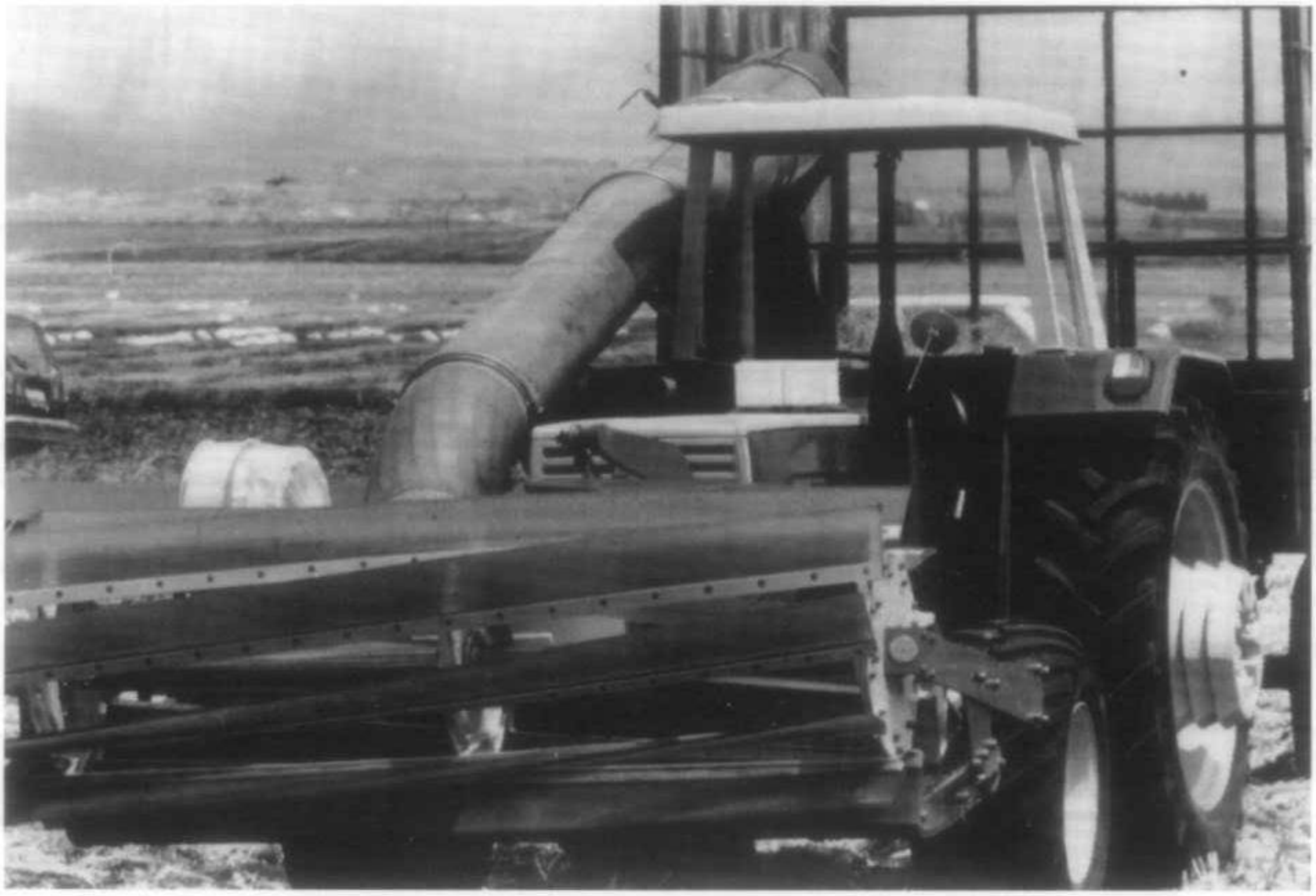

Fig. 7: Lentil Puller designed and developed in collaboration with University of Göttingen Germany, (a GTZ Project)

3.3.3.2 Mid-Mounted Three-Cone Planter:

Conventional planters have limitations when a number of plots are to be planted simultaneously. Single-plot planters, and they are commercially available. To meet the need for multi-plot planters, a three-cone mid-mounted planter was designed and fabricated at ICARDA (Fig. 8). It could be mounted on the smallest conventional tool carrier. Whenever this multipurpose tractor is required for other farm services, the planting unit can be easily dismounted.

Three plots could be planted simultaneously, having plot width 1.50 m and working width of 4.5 m. This planter has the capability to plant all types of cereal, lentil, chickpea, and similar seeds, fulfilling the requirements adequate soil penetration, depth regulation, seed-furrow closure, and row tracking.

The planter incorporates three commercially available seeding units, a gear box and three sets of shares. The elements are integrated within an appropriate frame to be mid-mounted on the smallest tool carrier (Fendt 231 GT tractor). The entire load (including three operators) of the implement is concentrated on the symmetrical center and distributed along the middle beam. Therefore, the load is not concentrated on a single point.

The 60 cluster gear unit is powered by a cogwheel directly driven by the front ground-pto (rpm directly proportional to the forward velocity). The distance between grains can be varied from 2 to 40 cm, independent of tractor speed because the ground-pto is mechanically coupled to the rear-wheel transmission. The total transmission of the cluster gear is divided into three speed ranges. Within each range, 20 rotation clusters are available. This system allows a maximum plot length of 15.5 m. The rotating distributors are driven by three heavy-duty, 12-V electric motors, thus providing a uniform distribution of the seeds. The distance between the rows is variable. The minimum width is 10 cm, and the overall working plot width is 4.5 m.

Fig. 8: Mid-mounted 3-cone Planter mounted on a tool carrier

3.3.3.3 Compact Straw and Chaff Collector

On request of cereal scientists to evaluate the grain-straw ratio (yield factor), a compact straw collector was designed and fabricated at ICARDA to collect all straw and chaff without affecting the existing separation system of grain from chaff.

The principle of collection is based on aerodynamic principles, using gravitational forces and the inertia of solids (straw, chaff, and plant rest) to separate these particles from the airstream using streamlined obstacles. The principle is illustrated schematically in Fig. 9.

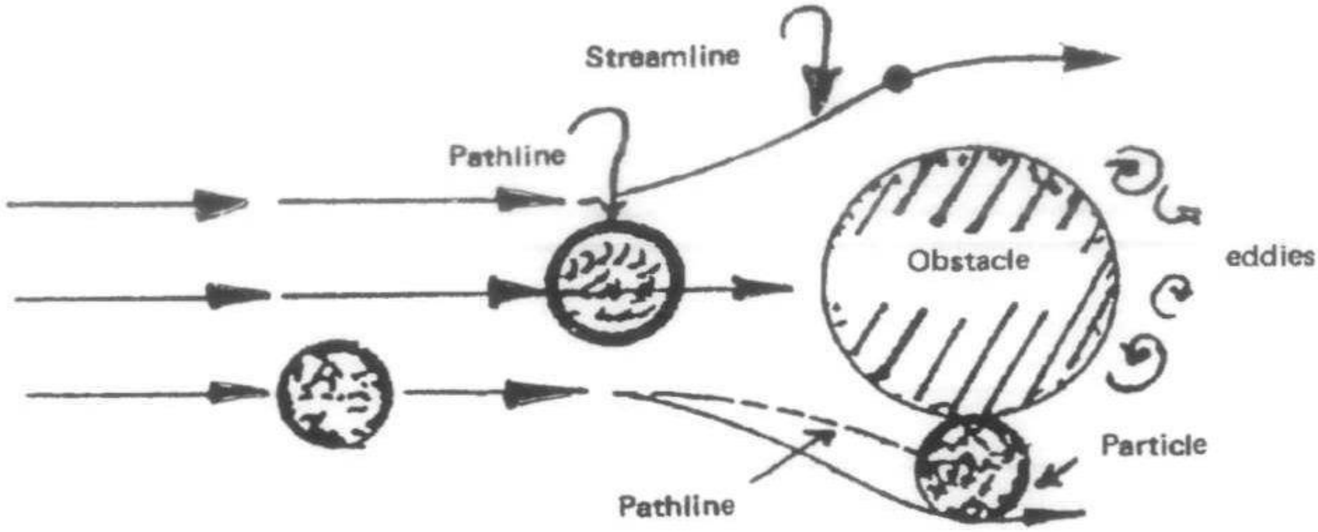

Fig. 9: Particles of three different sizes carried by the airstream

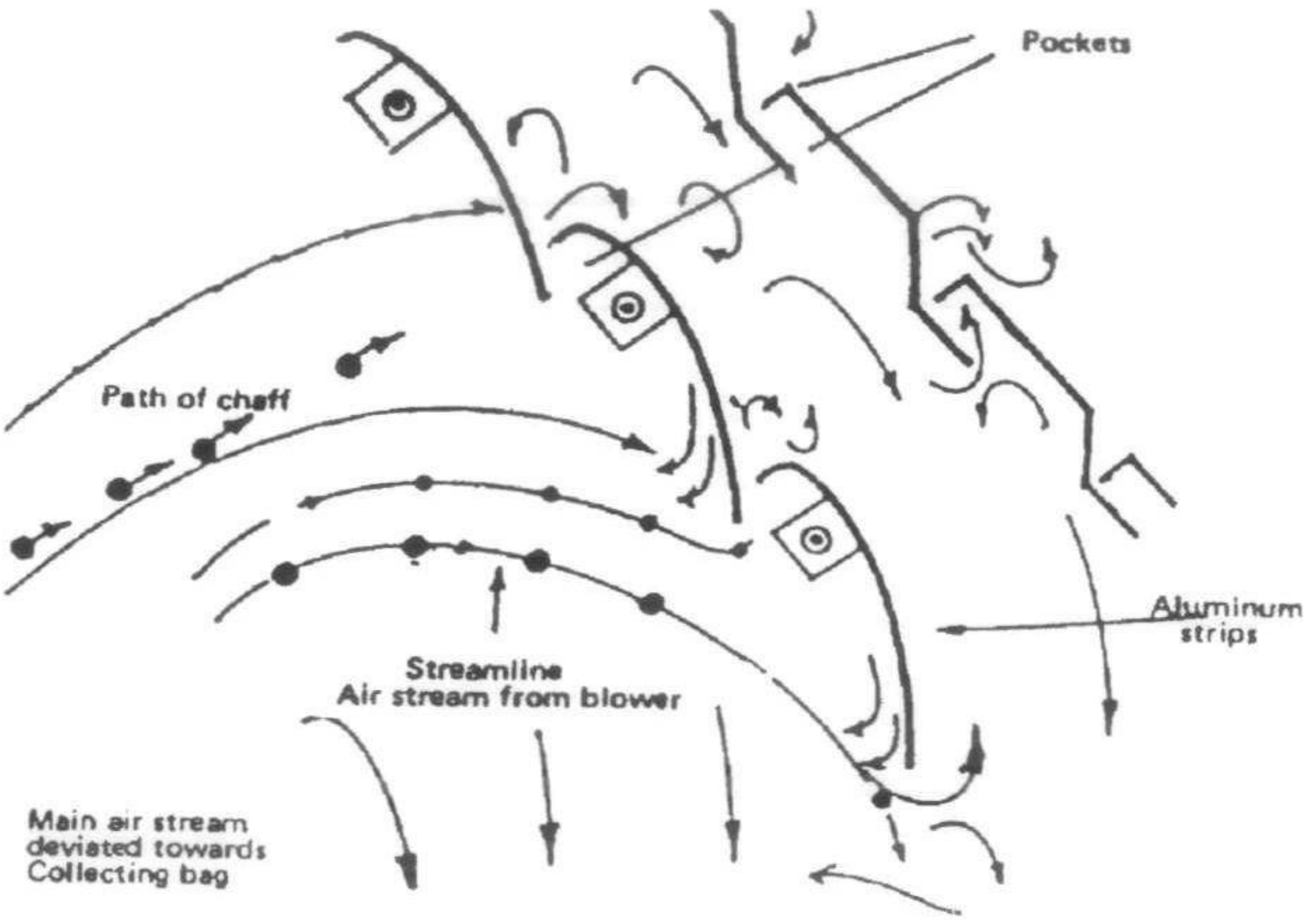

Fig. 10: A shematic illustration of first and second set of deflectors, used as obstacles

When an airstream carrying solid particles flows over an obstacle, it is deviated, whereas the solid particle continues in the path, due to its own inertia, and strikes the obstacle. Due to this impact on a series of carefully distributed obstacles, the particles are separated and at the same time a gradual dissipation of the kinetic energy is achieved. With the optimum gaps between the obstacles to allow a free flow of the airstream, efficient separation obtained.

Generally, back pressure takes place in the transition area, if the airstream is prevented from flowing freely. Fig. 10 illustrates the principle of separation, shows the sectional side elevation of the straw collector with two sets of grille louvres. The first set of aerodynamically formed aluminium grille louvres diverts the main airstream and also provides the straw collector with a dissipation chamber (the second set of aluminium grille hinged to the rear of the straw collector).

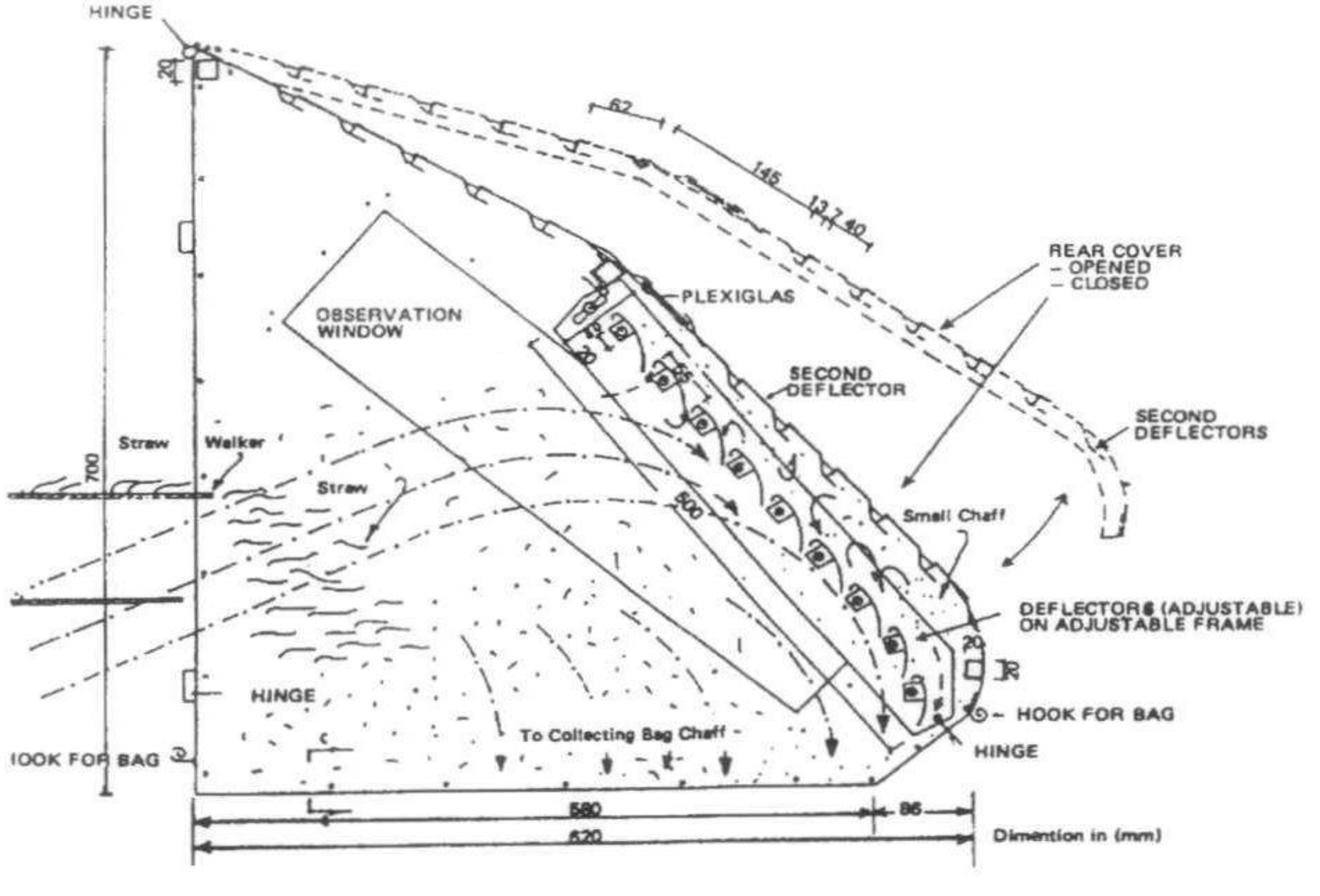

Fig. 11: Sectional elevation of the straw collector

The rear cover is hinged to the rear frame of the straw collector providing access to the rear of the combine for inspection. The cotton collecting bag allows the passage of the filtered airstream. The collection of bulk straw, chaff, and fine chaff are shown in Fig. 11 and 12. The bulk straw moves along the straw walker of the combine and falls directly into the collecting bag due to gravity. All the fine straw and chaff transported into the collecting by the main airstream.

The collector fits any plot combine without no additional mechanical propulsion is required, because main airstream generated by the combine blower is utilized for the entire collecting process. The main airstream which provides initial separation of much of the chaff from the threshed grain is deviated into a bag, which filters the airstream.

Fig. 12: The collector without the collecting bag showing the diverted bulk straw

Fig. 13: Removing the straw and chaff from the collecting bag

The straw collector weighs about 20 kg with dimensions of 68 cm x 85 cm x 65 cm. It fits into the rear opening (65 cm x 85 cm) of the plot combine. The collecting bag hooked to the bottom opening of the straw collector has the dimensions 80 cm x 70 cm x 55 cm, large enough to hold the 10 kg of straw and chaff. The bag is made from a woven material to allow passage of the airstream. The straw and chaff can be weighed in the field with a spring balance fixed to the combine.

4 Conclusion

The Green Revolution had its impact through the introduction of new crop varieties because of advanced agricultural science, but the contribution of appropriate, intermediate technology as well renewable sources of energy hardly encouraging. One sees several abandonned experimental plots.

To achieve the absolute development, the human reasoning has to be stimulated by introducing advanced technology and current techniques to meet the demand of the rising social standards. Development cannot be measured only by tonnage of food production or by yard stick. It is the available technology and the capabilities to utilize for the benefit of the target group that has to be assessed. Engineering application uses expanded human capacities, and improves their outlook and attitude towards the environment contributing to, by the physical and mental satisfaction. In addition, less demanding but repetitive and tedious tasks has to be handled by machines in conditions that make human involvement undesirable. For example, the production ares of lentil in the Arab World is declining because increasing cost and shortage of harvest labour make its production less economical for farmers. The mechanized harvesting such as the IDRC and GTZ (Fig. 5 and 7) have contributed to the local farmer to increase productivity. The range of application of science and technology is broad, and is increasing with many sectoral opportunities, from a simple machine to complex engineering.

When some early man, finding that he could not move a boulder, he took a sturdy branch, calling on one of the simple machines, the lever. Machine has done much to eliminate dull and distatefull work. The basis of much of our civilization lies in the advance of the machine throughout the ages. Without machines, and the know-how to develop and to use it, a nation cannot develop.

Although there are many potential applications for science and technology in developing countries, these should be selected and their use guided by experts. This requires a careful study and subsequent analysis. The principal behind the straw collector (Fig. 13) based on theories of fluid dyanamics and inertia. However the collector is simple, could be utilized by any rural farmer. Locally initiated and adopted solutions should be encouraged and supported in the lights of already matured technology.

For developing countries to gain from advances in science and technology, an effective means to share information on their use and provide assistance for their implementation must be provided.

5 Summary

Attempt is made, to reveal the philantropic contribution of the Center in its role as an extended arm of the industrialized countries, taking every effort to raise the social living standards and alleviate poverty in this part of the world, amphasizing the need to apply high technology.

Fig. 14: Areas guided by ICARDA. The main center in Syria

The main contents of this paper is focused on the engineering aspect, based on authors experience in operations and production management of research and development engineering at the International Center for Agricultural Research in the Dry Areas (ICARDA) in Aleppo, Syria. ICARDA is one of the 13 Centers established by the CGIAR, having its headquaters in Washington.

The responsibility undertaken by ICARDA is to guide and to provide the facilities for the betterment of the developing countries, by integrating into advanced science and technology. This is where most developing countries have a large deficit. Lack of scientific and technical facilities and skills to establish their own independent research and development, impedes the technical development, as well as socio-economic progress: The ultimate criterian for the evaluation of the standard of living.

An essential aspect of research and development philosophy is the factual approach to development. Perhaps there are several formal ways of improving the social living standards in the technically-handicapped countries, but the rapidity of modern technological change makes the search for appropriate methods a permanently necessary feature of a research center. Thus these centers evolve into integral part of the host country but have to be managed on generous grant from the industrialized nations. Considering here three types of resources in the engineering applications: software, hardware and human for chieving set targets, it seems, wiser and promising to emphasize technical resources rather than just funding.

The big work behind the evaluation of achievements is in finding and acknowledging the facts and circumstances concerning technology, value for money and its impact on the target. Value for money, a phrase used to summarize three basic components, which public sector organizations are aiming to achieve: Economy, Efficiency and Effectiveness.

Considering all these factors, it takes more than a conventional structural design of an organization, to ensure management. No organization is sounder than the men who run it and delegate others to run it. One of the Center's achievement is that it was designed to be an objective organization, as distinguished from the commercial institutions that gets lost in the monitorial profit making, or in the subjectivity of personalities.

Zusammenfassung

ICARDA (International Center for Agricultural Research in the Dry Areas) liegt 30 km südlich von Aleppo (Syrien). Das CG-System (Consultive Groupe for International Agricultural Research), dessen Hauptsitz in Washington ist, umfaßt 13 solcher Zentren. Das Forschungsgebiet von ICARDA liegt in ariden Gebieten mit Winterregen von 200 mm bis 600 mm. Forschungsschwerpunkte sind in der Züchtung und Ertragsstabilisierung von Weizen, Gerste, Linsen, Kichererbsen und Ackerbohnen, mit dem Ziel die Nahrungsmittelproduktion in den Entwicklungsländern zu erhöhen.

ICARDA's Zentrale liegt nicht weit entfernt vom ehemaligen Mesoptanien und Babylon, Orte die sich durch frühe Hochkulturen auszeichnen. Heute gehören diese Regionen zu den Entwicklungsländern. Die Maßnahmen zur Bekämpfung von Armut und Hunger in den Entwicklungsländern müssen auf einer Nutzung von modernen Technologien und lokalen Ressourcen basieren. Die Verbesserung der Mechanisierung in diesen Ländern ist eine komplexe Aufgabe. Heute haben die landwirtschaftlichen Maschinen und Geräte einen hohen Entwicklungsstand in den industrialisierten Ländern. Dessen Integration mit den traditionellen Methoden ist jedoch nicht zu vernachlässigen. Insbesondere darf nicht übersehen werden, daß der Mensch oftmals zum begrenzenden Faktor wird, weil seiner Leistungsfähigkeit bei der Informationsaufnahme von seiner Umgebung Grenzen gesetzt sind.

ICARDA als verlängerter Arm der industrialisierten Länder muß die Bedeutung einer fortschreitenden Mechanisierung in diesen WANA-Gebieten (West Asia und North Africa) in traditionelle Methoden integrieren. Hierzu werden die Entwicklung von Linsenerntemaschinen, einem Pflanzgerät und einem Stroh- und Kaffsammelgerät für Feldversuche in der vorliegenden Arbeit kurz beschrieben.

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