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ADVANCE NOTES ON SYMPOSIA AND DISCUSSIONS

SECTION OF AGRICULTURAL SCIENCES

President : S. Y. PADMANABHAN

I. OUR RURAL ASSETS AND LIABILITIES

Tribal Development

1. Tribal Welfare through Integrated Agricultural Technology.

I. K. BARTHAKUR (Shillong)

The different Scheduled Tribe (ST) communities of the country have achieved different socio-cultural and economic standards and are at different receptivity levels. Agriculture is their main occupation. The shifting cultivation is widely practised and has profoundly influenced the socio-cultural and economic life of the people. Whatever happens to this practice and agriculture, effects the people. Weaning away of the people from this practice, demands deep understanding of the reasons of its persistence. The welfare target may be taken to be the assemblage of integrated agricultural technology packets suiting different tribal groups set in the ecological fusion of their particular social and cultural traits, and then linking the resultant with the pinion of the country's economic development. Such an approach is likely to lift the primitive economies to higher level by skipping a number of evolutionary steps and achieving growth with the least possible stress and strain. The programmes have to be tailored to suit the receptivity levels, other socio-cultural and economic conditions of each tribe or a group of similar tribes. To achieve the welfare targets, right manpower at all levels is of paramount importance. And this may be taken to be the weakest bridge between thought and result.

2. Improving productivity of Jhum cultivation with special reference to the north eastern hill region.

D. N. Borthakur (Meghalaya)

Jhuming or shifting cultivation is one of the most ancient systems of farming practised primarily in the wet tropics of the world. In India, it is primarily prevalent in the North Eastern Hill Regions. The essential features of the system are selection of a jungle site on a hill slope, clearing and burning of the jungles and growing and intimate mixture of essential crops by dibbling. The area is abandoned and left fallow usually after two years of cultivation when the farmers or jhumias shift their field to another new site and repeat the processes mentioned above. They come back to the same site again after a lapse of 6-10 years which is known as the jhuming cycle.

Jhuming is presently practised even in the steepest hills. The ill effects of jhuming are erosion of top soil and fertility, deforestation, sedimentation of rivers flowing from hills leading to floods in the plains. Agriculturally, it is an unproductive system of farming where not only the top soil with fertility is removed, but no advanced technology can be practised including use of fertilizers and implements. As a result, the jhumias have remained as the most economically backward people staying practically half starved.

The measures to improve productivity have been grouped under short term and long term measures. Since jhuming will have to continue for a considerable period until jhumias are all settled permanently, it will be necessary to restrict it to proper slopes, with measures to check loss of soil and fertility through selection of suitable crops and proper farming systems. Modern technology such as use of improved varieties, agronomic techniques etc. have to be introduced. Long term studies are required to find out the period of erosive rainfall, nature of terraces depending on soil type, gradient etc., proper water conservation methods based on concepts of water shed management, cropping patterns and suitable implements, for suggesting measures of improving productivity and settling the jhumias permanently.

Since jhuming is a way of life and part of culture of the community, the approach should be such as could be adopted to their environment with least disturbance to their social structure.

3. Preliminary Observation on Ecological Aspects of Jhum Cycle.

P. S. RAMAKRISHNAN (Shillong)

Shifting cultivation which is commonly called 'Jhum' cultivation is widely practised by the hill tribes of the north-east. Under increasing population pressure, this is a wasteful practise resulting in rapid deterioration of soil and the forest cover. The ecological implications of this has not received any attention so far. Recently, work was initiated by the present worker on this problem, involving nutrient and hydrologic cycling, population and community dynamics of the disturbed ecosystem and these are discussed in detail. Further, the functioning of the agro-ecosystem under Jhum cultivation and alternative crop systems that may eventually replace Jhum cultivation needs to be worked out. These aspects of agro-ecosystem analysis have been considered and the need to understand the weed-crop interaction and biology of weeds in these croplands have been emphasized.

4. Tribal welfare through Integrated Agriculture Technology.

R. P. CHAUDHURY (Gauhati)

Agriculture is the foundation of the welfare of any society and it is more so in a society of tribal people. Agriculture amongst most tribal people, particularly those living in hilly areas in this country is in the primitive stage, agricultural output is very meagre and cultivators are below subsistence level. Therefore, for the welfare of tribal people the standard of their agricultural practices must be improved. However, while attempting to do this great care must be taken to do this by adapting this to the environment and culture including food habits of the land. This should be done step by step i.e. first to bring the cultivators to the subsistence level by helping them to use better varieties of crops already used by them and by adopting better techniques for their traditional system of cultivation. Nothing should be done to reform tribal agriculture by prohibiting its traditional methods out right.

The success of modern technology in Agriculture will depend on the education of the people. Therefore, attempt to spread education and improved agriculture technology must go hand in hand. New agricultural technology needs to be developed for peculiar environment in most

tribal areas, viz. Arunachal Pradesh with its heavy rainfall and steep hillsides.

Rural Development

5. A Proposal for Renewal of Human Settlements.

Sushil Chandra (Ludhiana)

Condition of existing villages in India is evaluated and the pattern of investment there over the last 20 years is discussed. It is indicated that investment in villages has not ameliorated the condition of villagers very much. An alternative is suggested in the form of new growth centres, started from scratch. The new cities, like Chandigarh, would provide all modern facilities to the populace and would help in eliminating villages as they exict now.

6. The village situation in India and reorganisation of its agricultural resources.

P. K. Sen (Calcutta)

An analysis of the village situation in India has been made in a thorough socio-economic survey of a representative village. Also a series of pilot experiments have been conducted in the same village over a decade proving the possibilities of its agro-economic development. The results are briefly reviewed.

The one-time community organisation and self-generating economy of the village based on social consciousness and full employment through division of labour have broken down. It has resulted in unemployment and under-utilisation of resources leading to poverty, loss of self-reliance and stagnation. The pilot experiments have clearly brought to light the possibilities reorganising its own resources of man and material aiming at improving the personality (skill) and social attitude of its people through productive action programmes.

A model of such reorganisation of the village resources bringing modern sciences to the aid of agriculture and linking it with industries in an organic way is presented.

Dairy Development

7. Development of computer based systems for dairy development projects.

P. N. DAULATJAD AND M. R. DESAI (Anand)

Tasks involved in planning, implementation and monitoring of Dairy Development Projects divide themselves into three major classes : Milk Production Enhancement, Increasing the Milk Processing Capacity and Evolving Effective Distribution systems for Milk and Milk Products.

These tasks call for collection and analysis of large volume of data and management information systems for timely and effective planning and control. The cheer magnitude of data to be handled requires these systems to be computer-based.

This paper looks at various computer-based systems from the milk producers to the consumers.

8. Dairying as a part of the small farm holding system for improving the economic conditions of rural people-based on our experience with the demonstration dairy farms.

A. A. CHOTHANI AND D. S. THAKUR (Anand)

This study has been conducted in Gujarat State. It analyses the extent to which progressive dairying can improve the economic conditions of rural people. The analysis indicates that the returns obtained by the farmers from fodder crops and dairying are considerably higher than the returns from cereals and other cash crops, the farm incomes can be raised by about 100 per cent through the adoption of optimum farm production plans with optimising the fodder production required

on each farm and progressive dairying offers a great scope for increasing the total incomes and profits of farmers in general and that of small farmers in particular in the milksheds where effective facilities for marketing of milk have been created.

Problems of Sheep Farming

9. The problem of Ram Semen Storage in relation to Fertility in Sheep.

K. L. Sahni and S. B. Tiwari (Jaipur)

With the introduction of cross breeding programme for increasing the productivity of sheep, the role of artificial insemination is bound to increase. The use of freshly diluted semen of native and exotic rams has given encouraging results but a marked drop in lambing rate has occured when semen used was stored for 24 hours in the cow milk diluent at 5°C. The optimum dilution rate consisted with the maximum viability during storage has been observed to be about 1 : 10. The dilution rates lower and higher than this ratio have resulted in the loss of motility of spermatozoa during storage. A direct relationship exists between the sperm concentration per unit volume of a diluent and the viability during storage within certain critical limits. The problem of loss of fertility has been attributed to a large extent on the insufficiency of number of spermatozoa available in the inseminating dose used conventionally. The results of small fertility trials conducted under controlled conditions have been discussed with a view to identify the problem and its solution through a coordinated approach. Recommendations have been made for evolving a satisfactory diluent for retention of fertilizing capacity of ram semen during storage (including deep-freezing), determination of optimum number of aged (stored) spermatozoa consistent with optimum fertility, assessment of biochemical damage and significance of acrosome changes during storage in relation to fertility in sheep.

10. Canary colouration of wools in India.

Manohar Singh and R. M. Acharya (Jaipur)

Non-scourable yellow (canary) colouration of wool of autumn clip from sheep in North Western India affects about 22 per cent of the

country's annual wool clip. This colouration commences in the later part of June (max. atmospheric temperature 43°C, Relative Humidity 57%). Intensity and extent of colouration increased with the increase in atmospheric humidity even when there is decline in temperature.

Biological factors such as low level of nutrition, body size, age, sex, skin follicular characteristics, and wool wax content had little influence whereas fleece density and suint content had a marked influence on colouration. Differential mode of heat dissipation, i.e. respiratory evaporation (planting) in Merinos and their higher corsses with Indian carpet wool breeds and cutaneous evaporation (sweating) in Indian breeds and lower crosses, explains the lower incidence of colouration in the former groups than in the latter specially those with denser and less coarser fleeces. In such breeds there is interference with evaporation of sweat, thereby, allowing a prolonged contact of alkaline suint with fibre which brings about chemical changes leading to yellow colouration. The canary colouration appears to be a sequel to the adaptive mechanism to climatic conditions and managemental practices requiring dissipation of body heat through cutaneous evaporation.

Sheep in India are usually shorn twice in a year (Spring and Autumn). Preponing of autumn shearing to the later part of June and providing managemental practices to protect sheep against solar radiation and metabolic heat load, at least till the wool is about 1 cm. in length, will markedly reduce the incidence of canary colouration.

11. The effect of water deprivation on certain aspects of sheep production under semi-arid conditions.

T. More and K. L. Sahni (Jaipur)

The effect of water deprivation for various intervals (24 to 96 hours) was investigated in terms of body weight changes, wool, meat and milk production in a small flock of Chokla sheep maintained on grazing alone for a period of two years. A water economy to the extent of 50 per cent was seen where Choklas were watered on second or third day. Water deprivation caused highest body weight loss to the extent of 21.7 per cent during summer season. The dry matter intake was significantly reduced when the animals were offered drinking water only once in 48 or 72 hours. The restricted water intake on alternate day resulted in a better food utilization under stall fed conditions. The biochemical changes in blood and urine of water deprived animals indicated

the inherent capacity of Chokla sheep to withstand the stress during periods of water scarcity under desert conditions.

The wool production was not influenced by any of the water restrictions imposed. The annual yield of about 5 kg gressy fleece weight per Chokla sheep indicated a high wool production potential of this breed under good management. The carcass weight was reduced in the water deprived group but the dressing percentage was slightly better as compared to the control. The water deprivation had resulted in the reduction of the weights of almost all vital organs. The milk production was affected adversely to the extent of 10 to 30 per cent in rainy and summer season respectively in the water deprived animals. The moderate degree of water deprivation did not affect the efficiency of reproduction in any season of the year.

The low potassium animals (LK) consumbed more water than the high potassium (HK) animals and by drinking less water, the HK animals have shown their superiority in adaptability particularily with respect to water stress and overall mortality.

These investigations strongly point to the need of conducting more similar experiments on the cross bred sheep wit ha view to assess their water requirements in relation to adaptability for improved production.

12. Need for integrated efforts in transfer of technology.

K. V. Ahmed Bavappa (Kasaragod)

A critical study of the existing situation in the transfer of available technology has shown that factors such as isolated handling of the agriculture, non-availability of inputs in time and in adequate quantities, ineffectiveness of the existing extension agency, absence of leadership to bring together the existing agencies and non existence of any system for analysis of operational bottlenecks and to right the defects have been by and large responsible for the limited impact of the efforts made so far on rural transmission. Attempts made to overcome this situation through an operational research project on gardenland management indicated that many of these defects could be remedied. However credit system, particularly in the co-operative sector and education of a certain section of the farming community, are the two important areas that will require massive efforts and change in the existing procedures.

13. Attempts towards transfer of improved rice technology to farmers with particular reference to Andhra Pradesh.

D. V. Seshu (Hyderabad)

Rice production plays an important role in rural and national economy. Recently, several high yielding rice varieties and appropriate management practices have been developed. Farmers' yields are yet to match with available technology. Operational research on rice has been initiated to determine the production constraints under farmers' environment and identify means to overcome them and thus effect a socio-economic uplift.

In Andhra Pradesh, two operational research projects have been initiated during 1973-74, one on rice production (Nalgonda area) and the other on integrated pest control (Warangal and Bapatla areas). The results are indicative of (1) the merits of dwarf rice varieties, (2) the advantages of management practices with greater reliance on non-monetary inputs, (3) the rationale in an integrated approach to pest control, which is less expensive and efficient in contrast to exclusive reliance on chemicals and their indiscriminate use leading to environmental pollution.

14. Preliminary Report on an attempt to mass transfer the technology of Rice Production.

J. P. Kulshreshtha and S. Y. Padmanabhan (Cuttack)

The feasibility of increasing and stabilising rice production by mass transfer of modern technology is being tested under two Operational Research Projects in India.

1. *The Operational Research Project on Integrated control of rice pests.*

The object of the integrated pest control is to develop a system of pest management whereby all the relevant techniques and methods of control are used compatible with minimal use on toxic chemicals. The use of pesticide is to be integrated in such a way that their harmful side

effect are minimised so that they do not act as environmental polutants and do not harm natural enemies of insect pests. Integrated control of rice pests has been taken up in the states of Orissa, West Bengal, Madhya Pradesh, Andhra Pradesh and Kerala. Gall midge during *kharif* season and stem borer and brown plant hopper during *rabi* season are the major pests in Orissa. Gall midge and green leaf hopper during kharif and stem borer and brown plant hopper during *rabi* season are the major in Orissa. Gall midge and green leaf hopper during kharif and stem borer and brown plant hopper during *rabi* season are the major pests in West Bengal. Gall midge during *kharif* season and stem borer and brown plant hopper are the major pests in Andhra Pradesh. Gall midge, green leaf hopper and white backed plant hopper are the major pests in Madhya Pradesh. Brown plant hopper is the major pest in Kerala.

The technique adopted for this purpose would cover :

1. Breaking the life cycle of the pest by destruction of stubbles and alternate host plants.

2. Adjusting time of sowing, planting and harvest of the crop in such a way that the crop is not available for carryover of the pests.

3. Growing varieties tolerant to the major pests of the area.

4. Early detection of the pest by forecasting and surveillance by the farmers trained in identification of the pests.

5. Minimal use of the insecticide when the pests damage reach economic threshold.

6. To avoid use of pesticides injurious to parasites and predators during the period when they are active.

The experience in control of gall midge in Orissa during *kharif* 1975 shows that gall midge damage can be avoided by (i) direct sowing early maturing short duration varieties in up lands (ii) by sowing and planting of medium duration varieties before August when gall midges reach its peak (iii) growing of gall midge resistant varieties like Shakti and CR. 94-MR. 1550 in medium lands and gall midge tolerant varieties CR. 1014 and Jagannath in low land.

Destruction of stubbles by ploughing them in soon after a harvest of *kharif* crop reduced stem borer incidence during the next *rabi* season.

1. *Operational Research Project on Rice.*

The object of this project is to increase rice production by mass adoption of new technology. This is being carried out in the states of Orissa, West Bengal and Andhra Pradesh. The project envisages classification of lands according to their situation into, upland, medium land, low land, rain fed or irrigated and to adopt intensive cropping patterns, suitable for such lands. The technology adopted for this purpose is :

1. Proper land preparation and shaping, timely planting and sowing in lines instead broadcasting direct seeded upland crops, by introduction of additional power tillers, tractors and other improved implements.

2. Efficient use of available water. Increasing area under irrigation through proper water management and removal of water legging by proper drainage.

3. Adoption of intensive crop rotation. Early planting by raising community nurseries with available water.

4. Efficient use of green manure, organic manures and fertilizers.

5. Integrated pest management, by surveillance forecasting and use of pest resistant varieties.

6. Development of subsidiary occupations for providing employment to small farmers and landless labourers.

The experience during *kharif* 1975 in execution of the programme has shown that :

1. Providing power tiller on hire enables farmers in timely preparation of land and planting.

2. Growing a short duration variety like Annapurna, Pusa 2-21 in uplands makes the land available for second crop of pulse in unirrigated land, Potato, vegetagles and fodder in irrigated areas.

3. Gall midge resistant varieties like Shakti and CR. 94-MR. 1550 give a good yield upto 4.5 tonnes without use of pesticides.

4. Planning for seed has to be done one season in advance to make the seed available in time.

5. Fertilizer and necessary credit for their purchase through bank or cooperative society should be arranged ahead of crop season.

6. Small village tanks owned by individual farmers can adopt scientific fish culture to supplement farmers income.

7. Large population of local cows of the area can be used for up grading through artificial insemination for raising the income of the farmers.

The chief socio-economic disability blocking mass adoption of technology involving increased in-put is the difficulty in providing in-puts to fields cultivated by land-less labourers. They are not themselves creditworthy according to the criteris adopted by banks and cooperative societies. On the other hand the land lord who takes away half of the yield evinces little interest in investing in in-puts.

15. Television for Potential Rural Entrepreneurs in India : A Linkage Model for Development.

Dr. N. P. Singh (Hyderabad)

Earlier studies indicate that it is now time to make the point more sharply by acquiring adequate service utilisation of television in collaboration with localised rural training institutions. Rural population mainly comprised of farming families, is the potential receivers of our massive television expansion network. Satellite instructional television experiment has already come under operation and service utilisation of the super media through envisaged model requires to have a serious thought by farm or rural entrepreneurial promoters as well as by media planners.

Author lays a grounding to promote entrepreneurial training programmes while linking the training design with the existing television programmes with an objective to induce harmonious growth with equality and social justice to different developmental activities on going in the rural areas. Those afflict televillages where teleclubs are not functioning properly can also be mobilised and revived. Provided television perceives the basic needs of its intended receivers having its feedback system more stronger. Multi-media information support to a potential farm entrepreneur, at the same time television viewer would strengthen in becoming and establishing successful enterprise.

Postulates of the model reveal with the challenges that Indian television faces depend on the tasks it performs for the rural audience. The wave of fantacy woven around development can only be brushed aside if message media and men operate in one system of appropriate linkage and work for entrepreneurial growth in rural sector.

HANDICAPS

Energy Problems

16. Animal and Human sources of Energy.

A. R. Rao (Hissar)

Of the energy resources of India in 1965-66, (a) only about 20% of the total energy needs were provided by all the commercial resources put together, like, coal, hydroelectric power and petroleum; (b) non-commercial sources such as wood, vegetable waste and dung cakes provided over 30%; and (c) living sources which include human efforts, animal efforts and bullock carts, nearly 40%. Thus, animals and man contribute the majority of the energy needs of India. Projections till 1990 anticipate continuation of this trend.

In view of their maintenance requirements even during periods of idleness, man and animal are basically less efficient than machines as over-all converters of dietary energy into work.

However, their comparative costs per unit work are becoming more favourable due to the increasing prices of fossil fuels. The abundance of these living sources of energy and rural employment requirements indicate the necessity to nurture these resources.

Only 30% of the cultivated area of the country is under large operational holdings and calls for the mechanization of agriculture. This area is likely to be further reduced by the current land reforms.

Thus, there is necessity to improve the efficiency and utilization of bullocks and other draught animals as well as human labour in agriculture, short-distance transport, etc.

Social Problems

17. Problems of soil salinity, alkalinity and acidity in India and their management.

J. S. P. YADAV (Karnal)

Agout 7 million hectares of land are affected by soil salinity/alkalinity in India. The important characteristics of various types of saline alkali soils encountered in different parts of the country have been described in detail. The problems presented by these soils for crop production have been discussed. The work done on different aspects including use of organic and inorganic amendments, leaching, drainage, agronomic practices etc. to reclaim and utilize these lands for agricultural production particularly at the Central Soil Salinity Research Institute, Karnal, has been summarized. The various trees and grasses which can be grown on these soils have also been indicated. Some details of an Operational Research Project on reclamation of Alkali soils being conducted at present in Karnal district by C.S.S.R.I. have been given. The extent and nature of acid soils and the problems posed by them with regard to their management have been discussed. An account has been given of the availability of important plant nutrients and of the microbiological activities in the acid soils. The research carried out on lime application and its effect on nutrient availability in acid soils has been elucidated. As the area affected by soil salinity, alkalinity and acidity in India is fairly large, systematic critical research needs to be intensified in order to develop technically sound and economically fessible methods for their reclamation and utilization for agricultural production.

18. Problems of rice production in acid soils and their amelioration.

S. PATNAIK (Cuttack)

Soil problems associated with acid red, laterite and lateritic soils and acid sulphate soils growing rice have been enumerated. Acid red, laterite and lateritic soils could be ameliorated through balanced application of N, P, K, application of ameliorants like lime and calcium magnesium silicate. On these acid soils, which were P-deficient and had high P-fixing capacity requiring higher rates of phosphate appli-

cation, rock phosphates at normal rates of 40-50 kg/ha P_2O_5 could be made as efficient as watersoluble phosphates by their application to moist soils 2-3 weeks before flooding and puddling.

The acid sulphate soils could be ameliorated for growing rice through application of lime, manganese dioxide and/or nitrate and kept them constantly flooded. This ameliorating effect was however short-lived since the problems got regenerated when these soils dried after harvest of the rice crop. There was scope for the use of magnesium silicate or carbonate as an ameliorant which had a longer lasting effect.

19. **Role of improved technology for reclamation of alkali sols in rural transformation.**

J. S. P. YADAV (Karnal)

Owing to the growing heavy pressure on agricultural land the paramount importance of utilizing salt affected soils for agricultural production has been emphasised. The details of the new technology for the reclamation of alkali soils developed at the Central Soil Salinity Research Institute, Karnal have been given. Good yields of paddy and wheat crops have been obtained on farmers' fields by adoption of this technology. In order to test the applicability of the technology on a large scale, an Operational Research Project on reclamation of alkali soils has been undertaken by the Central Soil Salinity Research Institute, Karnal. This is an integrated approach to improve the overall economic condition of the farming community. The various benefits likely to acrue from the implementation of the Operational Research Project have been described. The methods of introducing the social audit principle in the scientific upliftment of the rural economy resulting from implementation of the Operational Research Project have been outlined.

20. **Soil and water conservation in India.**

DR. K. G. TEJWANI

1. *Problems of Conservation of Land and Water*

At present there is very little area in India free from the hazard of soil erosion and destruction of land as a natural resource. It was esti-

mated in 1968 that out of 306 m ha of reporting area, 145 m ha were in need of conservation measures (Anonymous, 1968). However in 1975, it is estimated that 69 m ha are critically degraded and 106 m are severely eroded (Bali, 1975). More over, as the pressure on land increases, there will be tendency and demand to open up marginal and steep lands for cultivation. These lands will be in greater need of soil and water conservation.

Sediment is certainly one of our greatest agricultural pllutants particularly of water. In a country like U.S.A. even after 35 years of effort and expenditure of large sums of money there has been little if any reduction in the overall sediment load in the U.S. streams mainly due to increase in its non-agricultural activities. In India, the situation is infinetely worse, since the sediment load from agricultural lands not only continues unabated but is also on the increase and the sources of sediment are multiplying due to the fast rate of our developmental activities.

In fact, if erosion is permitted to continue at its present rate, it is possible that all work may be reclamation, rather than soil and water conservation and management. It is however fortunate that, at present in our country, soil erosion is now being considered one of the two most important liabilities and conntraints on agricultural production (Swaminathan, 1).

2. *Causes of Erosion*

The paper ellaborates the main causes of erosion viz. human population, cattle population, size of land holdings etc.

3. *Factors influencing Soil Erosion*

Among the factors influencing the soil erosion by water, the role of quantity and intensity of precipitation, degree and length of slope, type of soil, nature of ground cover and land use have been discussed.

4. *Soil and Water Conservation Development Programme in India*

Regarding the Soil and Water Conservation Development Programme in India it has been shown that upto the end of Fourth Plan about 19 m have been treated at a cost of Rs. 3470 m.

21. Dryland Agriculture in India ; an assessment of limitations and opportunities.

S. K. SINHA (New Delhi)

Large parts of India have to depend upon rains for raising a crop. Sometimes, it is not possible to obtain even one crop in a year. Therefore, it is usually said that the research and its application to dryland agriculture are location specific. And yet, in all the regions almost a similar approach is exercised with minor variations of agronomic treatments and crop varieties. For social development and uplift this approach may be questionable. Firstly, the situations in different regions should be defined. We encounter basically the following situations :

(a) Regions where one good crop is possible once in three to five years.

(b) Only one crop is possible in a year. The chances of success are 2 times in three years.

(c) Regions where one crop is almost certain but a second crop is possible provided that one or two supplemental irrigations are available for the second crop.

Thus, it would be clear from the above that the development of agronomic practices alone does not provide answer to the problem of social development and uplift in all the regions. What is needed is the integrated development of the region. In this effort, the identification of natural resources including the man power and potential for the planned development of small-scale industries, dairy development, aforestation and horticulture are some of the components which can be integrated.

Therefore, what is needed is an integrated agricultural and social philosphy for rural transformation and development of different dryland regions rather than simple agronomic experiments alone.

Pests and Diseases

22. Control of rice diseases.

N. K. CHAKRABARTI (Cuttack)

Rice the most important food crop in India, suffers from large number of diseases of which blast, helminthosporiose, sheath blight, bacterial

blight, tungro and grassystunt viruses are of major importance. Occurrence of such diseases have been found to be factors limiting higher production in rice.

Control of diseases could be achieved by (1) direct application of fungicides (2) through adoption of suitable agronomic practices and (3) by growing disease resistant cultivars. Number of fungicides have been identified which can control blast, helminthospriese or sheath blight to certain extent. Many of these chemicals however are either too expensive or in some cases not available in the market. Adoption of suitable agronomic practices like adjustment of sowing and planting dates, manipulation of fertilizer application, correction of soil deficiencies if any, improvement in water management practices and weed control are required for plant disease control. Growing of disease resistant cultivars if agronomically suitable is an inexpensive and surerer method of disease control. Attention should be paid for evolution of multiple resistant cultivars having fair degree of tolerance to more than one of the major diseases prevalent in the locality.

Under the circumstances it is necessary that our approach to control rice diseases should be an integrated method comprising growing of cultivars of high yielding ability with at least moderate degree of resistance to few major diseases/insects, adoption of improved cultural practices as mentioned above to help in checking the spread of the diseases and application of fungicides/ insecticides when absolutely necessary.

Studies on epidemiology leading to forecasting of diseases will help in identifying the factors responsible for disease outbreak. Application of fungicides linked with forecasting will help in minimising the cost of plant protection.

23. Recent advances in the control of diseases of Millets.

H. C. Govindu (Bangalore)

Millets which include Ragi, Sorghum, Bajra and other small millets occupy an important place in Indian Agriculture. Amongst millets sorghum is sown to a highest acerage followed by Bajra and Ragi. Out of a total area of 101. 446.6 thousand hectares under cereals in India,

millets occupy an area of 37,686.9 thousand hectares with an annual production of 20,262.1 thousand tonnes.

Several diseases of millets have assumed greater importance in recent years and the control aspects of these diseases has thus become more and more important. In the present paper recent advances made in the control of major diseases of Ragi, Sorghum and Bajra are discussed.

Blast caused by *Pyricularia setariae* is one of the major diseases of ragi. Several fungicides and antibiotics have been tried in recent years for the control of this disease. In a recent study, it has been found that Cerasan lime dust at the rate of 22 kg/ha applied once in 15 days after sowing followed by three fortnightly applications 20 days after planting increased the yield by 36.87% over control. While Bla-S, Zibeh, Edephenphos were less effective. Aureofungin (an artifungal antibiotic) is also reported to be equally efficient. Studies from Karnataka on the reaction of world collection of ragi to blast disease indicated that, of the 488 world collections screened none were reported to be resistant, 153 moderately resistant, 199 moderately susceptible and 145 susceptible. African collections showed highest degree of moderate resistance. Tamil Nadu, Mysore and Orissa collections showed highest number of combined moderate resistance to blast, *Helminthosporium* and *Sclerotium* wilt. Among the 806 improved varieties of ragi from different States of India, Sikkim, Africa and U.S.A. screened for *Helminthosporium nodulosum* 139 were resistant, 359 moderately resistant and 308 susceptible. Further, ragi collections from Mysore (39), Africa (38) and Tamil Nadu (34) had high percentage of varieties resistant to Helminthosporiose. These studies as well as screening against *Sclerotiumwilt* clearly indicated the availability of resistant varieties in States of Karanataka and Tamil Nadu.

A similar study on screening of varieties from India to *Sclerotium* wilt showed 322 resistant, 239 intermediate and 232 susceptible varieties among the 793 varieties tested.

In a fungicidal study on the *Selerotium rolfsii*—nematode disease complex PCNB gave the best control reducing the disease by 65%. In a preliminary insecticidal trial with Carbofuron in the control of the vector of ragi mosaic *Cicadulina bipunctella* a decrease in the population of the vector with a considerable reduction in the percentage of virus infection has been obtained.

Studies on control of Leaf diseases of Sorghum caused by *Helminthosporium tursicum* and *Colletorichum graminicolum* have shown that monthly applications of sulphur dust controlled the diseases and also increased the yield. A recent study on control of *Cercospora sorghi* and *Bipolaris* turcicum on Co. 1 and Co. 18 varieties of sorghum Dithane-Z-78 reduced the disease and increased the yield while copper fungicides caused phytotoxic effects. TMTD, Thiram and Fernasan have been found to be effective in controlling seed-borne fungi in storage without any deleterious effect on seed viability. TMTD was effective even at lower concentrations of 0.025%. Systemic fungicides vitavax and Benlate have been found to ge efficient in the control of *Rhizoctonia solani* the cause of seed rot and damping off of sorghum. In studies on breeding for rust resistance, resistant lines have been identified in a cross between Shallu (an exotic variety of resistant to rust) and a susceptible GM 2-3-1 varieties. Studies conducted on varietal reaction of sorghum to head smut, Sphacelotheca reiliana indicated that varieties Nandyal, I.S. 84, Karad-local, M 35-1, D 531-21B and CHS-1 to be resistant. Studies made on the reaction of various species and varieties of Sorghum to Sugary disease under green house conditions revealed that CSH-1, CSH-2, IS-1054, *S. membranaceum* to be highly susceptible while K_s *S. nodulosum*, IS-1122 and IS-5285 were resistant with least infection. The reaction has been attributed to be due to the nature of stigmetic secretions.

In studies made on the effect of sowing dates on incidence of Ergot and yield of hybrid bajra it has been observed that crops sown on 15th and 30th of July were not only free from the disease but also gave higher yields, delayed sowings increased the incidence of the disease at the same time reducing the yield. Increase in Nitrogen dose has been found to increase the susceptibility of the crop to Ergot. In studies on the control of Ergot disease of bajra it has been found that Aureofungin (0.0025%), Duter (0.25%) significantly reduced the disease. Three sprays at 5 days interval beginning with ear emergence effectively reduced the incidence and checked the spread of disease. In screening of varieties for ergot disease resistance all the varieties were found to be susceptible. Plantavax (at 10 ppm) was found to be inhibit the germination of spores in vitro while 100 ppm controlled the rust of bajra effectively when sprayed to plants. In a fungicidal trial in the control of smut (*Tolyposporium penicilliariae*) of bajra, the antibiotic Aureofungin was most effective followed by Ziram and Blitane. Of the 34 types of Bajra comprising inbred and open pollinated lines evaluated for the reaction to rust and green ear diseases, open pollinated lines were resistant to green ear infection. With rust infections open pollinated lines resisted the attack getter, the lines PT 826/4 and 829/5 were resistant to rust.

24. Importance of virus diseases of grain crops in India.

S. P. RAYCHAUDHURI (New Delhi)

Cereals and Millets occupy more than 100 million hectares in India of which wheat, rice maize, barley, bajra, jowar, ragi and oats are the important ones. During the last decade several important virus diseases have been reported on these crops in India at various Centres by several workers. It is true that while tungro virus of rice as well as grassy stunt which flared up recently in South India have been of great concern to all the agricultural scientists. There are many more which are coming into prominence and which need proper attention so that they can be kept under check. Mosaic streak of wheat was reported almost 18 years ago from Kalimpong which is transmitted by 4 active aphid vector. Now we have noticed this disease from other parts of the country as well which means that they are spreading fast. Recently streak disease has been reported on Hira variety of wheat which was first noticed at the IARI and now is known to be present in many wheat growing areas. Besides these, two more virus diseases have been reported on wheat crop. These are yellowdwarf and barley mosaic. Very recently, a hitherto unrecorded disease has been found on maize in the Darjeeling hills specially in Kalimpong area which has been designated as Vein enation disease. This disease also infects wheat besides rice, and ragi. Streak diseases are transmitted by a jassid vector *Cicadulina mbila while* vein enation is transmitted by C. intrila. In rice main problem is tungro besides yellow dwarf which is due to mycoplasma. Both diseases are transmitted by *Nephotettix virescens* and *N. nigropictus*. Tungro is spreading fast and now has been reported in many areas where the disease was not known earlier. Grassy stunt which is due to a virus flared up in South India has been noticed recently and needs further investigation. This disease is transmitted by brown plant hopper *Nilaparvata lugens*.

Maize which is next to rice, wheat, jowar, and bajra as food crops, suffers from mosaic disease as well as streak disease. Streak which is not mechanically transmissible was reported long ago by H. H. Storey from Africa, Mosaic of maize is mechanically transmissible and is also transmitted by aphid vectors is a strain of sugarcane mosaic. Barley suffers from a mosaic disease which is sap transmissible to barely and wheat. It is transmitted through seeds to some varieties of barley but not through wheat seeds. Cereal yellow dwarf infects wheat is ten aphid vectors including *Rhopalosiphum maidis* but is not self inoculable, while barley mosaic is transmitted by *Rhopalosiphum maidis* and is self inoculable. In jowar, yellow mosaid is very commonly observed in Andhra Pradesh, Maharashtra and Karnataka which is a virus disease

transmitted by *Peregrinus maidis*. Bajra suffers from streak disease and the symptoms resemble in early stages those produced due to Downey mildew. This means that Pathologists or Plant Protection Officers should be very careful during the survey work to make a statement whether or not the disease is due to downy mildew or due to streak disease. Besides streak, bajra gets infected with the mosaic disease and this mosaic disease is transmitted by *R. maidis*. This virus also infects rice. Ragi mosaic is well known in Andhra Pradesh, Karnataka and Tamil Nadu as well as in Kalimpong hills in West Bengal and it has 5 aphid vectors. Another ragi mosaic virus which has no vector is reported to be different from the one mentioned above. Yellow dwarf of rice is very well distributed in Orissa, Bihar, West Bengal, Andhra Pradesh and is caused by mycoplasma. This disease has been reported to cause serious situation in South India. There is a chance of its spreading rapidly unless it is taken care of.

Although a few important diseases of grain crops have been very briefly mentioned in this brief account, the picture is not very gloomy because sources of resistance have been determined in many cases in cluding mosaic streak of wheat, tungro of rice, maize mosaic, barley mosaic, streak diseases etc. Also the systemic insecticides like Furadan, 75% W.P. and Lennate—both have been found to be very satisfactory and effective in controlling the vector population under field conditions thereby checking both tungro and yellow dwarf diseases. The importance of grass and seed hosts in case ceral crops cannot be ignored since these are the sources of many of the important diseases. In collaboration with the CRRI, Cuttack and West Bengal Agricultural Department a lot of good work has been done by our group at the IARI and in collaboration with the AICRIP of Hyderabad attempts are being made to isolate different strains of tungro virus as some strains of tungro are very destructive.

Detailed account is given in this illustrated talk specially for the role of plant protection in Integrated Rural Development.

25. Conservation of potatoes by Gamma-Irradiation.

PAUL THOMAS AND G. B. NADKARNI (Bombay)

Of the total produce of potatoes in the country, only 20-30 per cent is stored under refrigeration. The remaining crop is either held

for short periods in farm store-houses or goes for immediate trade and distribution. Post-harvest losses due to sprouting, shrivelling, storage pests and diseases are estimated to be 20-30 per cent. With the present energy crisis, the growth of the cold storage industry has not been keeping in pace with the increasing demand for storage of perishable foods. In this context low dose gamma-irradiation offers an effective alternative method for storage of potatoes. A dose of 10 khad inhibits sprouting and also eliminates the potato tuber moth *Gnorimoschema operculella* Zell.

The irradiated potatoes also have greater resistance to greening and formation of the toxic alkaloid solanin.

Bacterial soft rot caused by *Eriwinia* spp is found to be the limiting factor in the long term storage of potatoes at ambient temperatures. Studies carried out over a period of 3 years with several commercial potato varieties have shown that extended storage of irradiated potatoes for 6 to 8 months with minimal losses is possible by holding them at 15°C. A preliminary cost estimate of such a procedure i.e. irradiation followed by storage at 15°C appears to be comparable to the conventional cold storage at 2-4°C. It is envisaged that post harvest losses could be substantially reduced by adopting such a procedure. The higher holding temperature may also permit construction of larger storage capacities.

26. Potential uses of Gamma-Irradiation for improving storage and transport of onions.

PAUL THOMAS AND G. B. NADKARNI (Bombay)

India is the worlds largest producers of onions with an annual production of about 1.5 million tons. Post-harvest losses on account of sprouting, dehydration and rotting are estimated to be 20-30 per cent of the production. The efficacy of low dose gamma irradiation for sprout inhibition was tested under laboratory and field storage conditions and during transportation.

Sprouting losses could be considerably reduced by exposing bulbs to 6 to 9 Krad of gamma rays when they were in the dormant period. The extent of sprouting was found to be more at low ambient temperatures (4 to 20°C) or under widely fluctuating diurnal temperatures.

Storage studies at 20°C showed that 90 and 80% of irradiated onions were marketable after 3 and 6 months storage respectively as against 40 and 0% in the unirradiated group. Storage trials in conventional storage sheds (chawls) conducted in Lasalgaon in Maharashtra, a major onion producing centre, with both Rabi and Khariff onions revealed that storage losses could be reduced by irradiation. The savings in total losses as a result of irradiation were 6, 18 and 20% at the end of 2, 3 and 4 months respectively. A transportation trial with Khariff onions between Bombay and Dibrugarh in Assam during winter showed that when the consignment reached Dibrugarh after a transit period of one month, 50-80% of the unirradiated onions had viable sprouts against 10-15% in the irradiated lots. Chemical, organoleptic and processing qualities of onions were found to be unaffected by irradiation.

27. Present status of pest and disease surveillance and plant protection training in India.

S. N. Banerjee and D. Srinath (Faridabad)

An account on the need and role of the Survillance in Plant Protection Technology along with the present status of Pest and Disease Surveillance in the country is given. The paper also deals with the Plant Protection training facilities available both at the Centre and States Level.

II. SCIENCE AND TECHNOLOGY IN RELATION TO RURAL DEVELOPMENT

Nutrition

(i) *Human Nutrition* :

1. Human nutrition in Agriculture and Agriculture Services in Rural Development (Nutrition).

P. N. Sen Gupta (Calcutta)

The adequacy of food supplies and better nutrition prerequisite for improving rural quality of life depends largely on appropriate

agricultural operations and equitable distribution. Incorporation of nutrition element in agricultural planning requires knowledge of nutritional requirements and available nutrients from the household diets. Estimates of nutrients requirements are of value to agricultural planning when these are translated into kinds and quantities of food needed to achieve higher levels of nutrition.

Average intake and requirement of any nutrient has no real significance. Information of the households of particular socio-economic groups suffering from food and nutritional deficiencies are indispensable. *Eight basic issues* involved in the problem have been outlined. Measures to promote production of foods of outstanding nutritional value and multimixes have been indicated.

The importance of agricultural services : extension, block development, home economists, in the implementation of the suggested *fourteen points* programme for rural development in nutrition are the *highlights* of the needed action programme. The in-service nutrition training of the agricultural field staff, inclusion of nutrition element in the curriculum of the University Faculties of Agriculture, at the graduate and post-graduate levels, and the utmost necessity of a nutrition unit in each of the State Department of Agriculture have been emphasised to cope with the exigiencies of the problem.

2. Nutritional Considerations for a Realistic Agricultural Policy.

A. R. Rao and I. J. Singh (Hissar)

It has been emphasized that to attain self-sufficiency in the various types of foods, agricultural resources will not be adequate for several decades to come. Under such conditions we should try to produce as many as possible of acceptable and/or cheaper substitutes for agricultural products. In this connection, the possibilities of producing substitutes, particularly for sugar, cotton, animal feeds, and foods of animal origin like milk, meat, ghee, etc. were discussed. Technology for their production is already available in India. Such alternative products will relieve the demands on the agricultural resources and allow them to be appropriated to the production of essential foods like foodgrains or oilseeds. Our findings were :

1. At present, most of the agricultural resources in India are devoted to foodgrains and other food crops.

2. Plants are better than animals as sources of human food, in terms of yields of edible products from the land. Animal products like milk, ghee and meat are extravagant to produce.

3. On examination, only sugarcane and cotton crops appeared dispensible to bring more land under the cultivation of more of the essential food crops. The distribution of land for these crops in the different states of India appeared to be irrational in terms of yields.

4. Coarse grains, wheat and pulses appear to be the least expensive sources of vital nutrients like energy as well as protein. Animal products have no place in a poor man's budget.

5. As against the land needs of about 0.45 to 0.48 hectares per head to produce the recommended quantities of foods, we have only 0.27 hectares of arable land.

6. Acceptable and cheaper alternative products (some of which are in common use abroad) for milk, ghee, meat, animal feeds, sugar and cotton have been suggested. Technologies for their manufacture are already available in India.

3. Processing of Cottonseed for edible uses—A review.

P. L. Narayana Rao *et al*

Traditionally cottonseed has been used as a cattlefeed. By genetic characteristics it contains a toxic sugstance, known as gossypol which is injurious to monogastric animals like poultry swine etc. and human beings. As the seed is a rich source of protein and oil, studies have been done to process the same to yield edible grade refined oil and flour.

In India, about 2.5 million tonnes of cottonseed are obtained from ginning mills annually. Setting aside about 10% for sowing purpose still 2.25 million tonnes are available for crushing and oil extraction. Due to pioneering studies conducted during the last 20 years on pilot plant scale at the Regional Research Laboratory, Hyderabad and Oil Technological Research Institute, Anantapur, (A.P.), economical viability of crushing of cottonseed for various end uses has been demons-

trated. Many industrial units have come up for producing cottonseed oil and refining of the oil for edible uses. Even now, only about 40-50% of the available seed is being crushed.

Process know-how was developed in Regional Research Laboratory to produce edible cottonseed flour to be used as supplementary food of excellent nutritive value. The flour is already used as food for growing culture in fermentation processes for preparation of antibiotic drugs.

Process involves delinting of cottonseed to remove linters, i.e., fuzzy fibre of short length, which can find its use as raw material for most of the cellulose based industries i.e. Rayon, explosives base for photographic films, paper etc. Delinted seed is dehulled to separate the seed coat which can be used as roughage for cattle feed. De-hulled seed i.e. kernels are scientifically processed and expelled to yield crude cottonseed oil and cake. The cake is solvent extracted to get de-oiled meal and solvent extracted oil. The meal is ground into flour for edible use and the oil from expeller and solvent extraction is refined to get edible oil.

To improve on the quality of edible flour, process development by liquid cyclone technique has been completed on bench scale and is being scaled up for establishing economics of the process and for preparing large quantities for trials.

4. Extraction and applications of Dhaincha seed gum.

GURDEV. S. DAVAR (Gwl.)

Dhaincha, known botanically as *Sesbania aculeata,* is a draught resistant, pod-bearing, nitrogen-fixing legume, cultivted, by and large, only for its contribution to soil fertility as a green manuring crop. Dhaincha seeds are available in abundance and at consistently low price. A neutral polysaccharide, branched galactomannan type gum has been extracted from the seeds of Dhaincha plant. After the gum extraction the resultant by-product is a protein concentrate suitable as animal feed upon its detoxification by known treatments.

No earlier investigation of Dhaincha seed gum and its derivatives

and modifications for industrial use seem to have been made. Purified Dhaincha seed gum behaves as an excellent water soluble gum readily adaptable to scientific development program. It hydrates in cold water forming viscous colloidal dispersions and exhibits good hydrogen-bonding activity. Some of its modified forms each best suited for a particular application or a series of related applications have been worked out besides its use as a conventional hydrophilic colloid established.

In conjunction with certain other plant seed hydrocolloids Dhaincha seed gum exhibits a degree of synergism as well as complementary and supplementary effects. Such compositions have offered suitable replacements for more expensive gums by this lowprice Dhaincha polysaccharide which coull find industrial use as an emulsion stabiliser, flocculating agent, viscosity-enhancer, Print-Paste thickerer and widespread application whenever there is a desire to modify the behaviour of water. Three years of processing experience now affords appreciable degree of reliability in using Dhaincha seeds as a potential source of essential and presently much expensive industrial raw materials for domestic consumption as also for the overseas markets on the lines of Gum Acacia, Gum Ghatti and Guar Gum which have well established export markets. New applications of Dhaincha Seed Gum are also being explored and future prospects seem to be good.

(*ii*) *Animal Nutrition*

5. Development of Feeds and Fodders in India.

S. D. N. Tiwari (Bhopal)

India ranks as a major agricultural country mostly dependent on animal power. The cattle population in the country is also high. Production of Feeds and Fodder, therefore, require concerted efforts for the development of cattle required for agriculture, dairy farming, manure skins and hides, wool, draft for vehicles etc. In this paper the problems connected with the Feeds & Fodder for the cattle are discussed along with the existing plan-arrangements for their developments. Suggestions for organising an independent integrated department both at the Central and State level, for developing feeds and fodder are given.

6. Importance of silviculture for nutrition of Animals in a rural economy.

B. C. Patnayak and N. P. Singh (Hyderabad)

Silviculture programmes are being emphasised for afforestation, soil conservation and desert development. Various top feeds that are presently available and would be available through the afforestation programmes could serve as potential feed resources for animals in rural areas. The need for intensive research to utilize the top feeds either directly or after suitable preservation/processing is emphasized. The work done on evaluation and utilization of various top feeds are presented.

Ardu leaves (Ailanthus excels RO × B) were fed as chaffed-green or dry and treated with molasses to Chokla rams. Dry matter consumption from green leaves was 3.8 kg/100 kg. body weight which was significantly higher than from dry leaves (2.3 Kg/100 Kg.). Sheep weighing 15 Kg. consumed 395 g. of ardu leaf meal and 328 g. of wheat straw/animal/day and the animals could maintain body weight. Dried Kankera leaves (Gymnosporea spinosa Forsk) were found quite palatable for Malpura rams. Dry matter consumption was 3.7 Kg./100 Kg. body weight. Green Kankera leaves could not provide sufficient nutrients to support the growth of hoggets when allowed to self feed on Kankera tree loppings. Neem leaves (Azzadiracta indica) were fed to sheep in (1) fresh green form (2) dried and treated with molasses (3) as silage and (4) meal form. Dry neem leaves were not consumed by sheep. Green leaves were consumed on an average 325 gm. dry matter/head/day and the animals lost weight. Neem silage treated with mineral mixture was more palatable than untreated silage or treated with molasses. Neem leaf meal was consumed when incorporated in concentrate mixture at 20% on weight basis. Shisham leaves (Dalbergis sisoo) were not at all palatable for sheep as green.

(iii) Plant-integrated nutrient-supply system :

(a) Organic recycling—

7. Recycling of Wastes and Agricultural Production.

T. M. Paul (Bombay)

In view of the non-availability and high price of the chemical-fertilizers in the rural areas, compost-making has a significant place not

only in the rural-economy but also in the environmental sanitation both in the rural areas as well as in the urban areas. A new method has been evolved in compost-making by combining both the animal-wastes and agricultural-wastes in such a way that all the agricultural-wastes normally burnt-away get converted into high-class compost. This is made possible by mixing the animal-wastes, particularly cow-dung with an equal quantity of water before it is allowed to undergo fermentation in a conventional gobar gas plant for production of methane. After the fermentation, the waste-slurry is allowed to spread in a compost pit on top of the dry fodder-waste, sweepings including dry-leaves, waste-paper etc. and weeds removed from the farm. With alternative layers of agricultural-wastes and waste-slurry from the gobar-gar-plant, the compost pit is filled over a period of six months. Thereafter, while the first pit is allowed to remain undisturbed for a period of six months, the daily-collection of the agricultural-wastes and slurry is put into a second compost-pit. At the end of the second six-month period, when the second compost-pit is full, the material in the first compost-pit is ready for removal and use on the farm. But till the first pit is emptied, fresh materials cannot ge put into it. Therefore, while the first pit is being emptied, fresh waste-materials are collected in a third compost-pit during the third six-month period. By the time, the third pit is full, the first pit would be empty and ready for receiving fresh waste-materials.

The quality of compost produced by this method is found to be superior to ordinary compost, in the sense that not only nitrogen, but phosphorous and pottassium are also considerably higher than in the rural compost. Besides, the quantitative output of compost is also more, mainly because all the agricultural wastes normally burnt-away, are also converted into high-class compost.

8. Composting of Rural and Urban Waste.

N. B. Sinha (Calcutta)

In broader sense composting method can be classified into two groups—mechanical and non-mechanical. Medium type of cities as well as villages, in general, have adopted the non-mechanical composting processes namely, Bangalore and Indone Method. In addition to this several mechanical composting processes are followed in India, namely, (1) Buhlar process, (2) Dano process, (3) Dorr oliver process, (4) Broyerus Gundard process, and (5) TRIGA process.

Scientific fermentation purpose of composting is to obtain maximum amount of humic colloid from the organic matter. The technology of composting is applied in obtaining optimum fermentation in minimum time. These involve in (1) Segregation of refuse and salvage, (2) chopping of refuse in order to increase the surface of materials for attacking by the microorganism, (3) optimum C/N ratio, (4) adiquate moisture content, (5) optimum temperature, (6) highly efficient strain of microorganism for rapid decomposition (mainly cellulose and lignin hydrolysing microorganism) and (7) seiving of compost through the appropriate mesh for proper utilization by plants.

Government of India has a target for Fifth Five Year Plan is 7.5 million tonnes urban compost and 300 million tonnes of rural compost.

9. Microorganisms and Agricultural Productivity.

G. RANGASWAMI (Coimbatore)

Soil is a living biological system and its productivity vis-a-vis fertility is reflected in the number of microorganisms harboured in unit volume. Several physiological groups of microorganisms play key roles in completing the cycles of Nitrogen, Carbon, Sulphur, Phosphorus and several other elements which are essential for life on earth. In recent years efforts are being intensified to exploit the organisms to bring better benefits for plants and through them to mankind.

Symbiotic nitrogen fixing *rhizobia* are being improved in their nitrogen-fixing quality. They are also induced to fix nitrogen non-symbiotically. Free-living bacteria, fungi and algae are also being used for fixing nitrogen in the soil and more specifically in the plant rhizosphere to increase crop production. Several other microorganisms with certain qualities such as phosphate solubilization, sulphur oxidization, auxin production and antagonism against pathogenic microorganisms are being utilized for better crop production. The role of microorganisms in minimising the harmful effects of pesticides on the ecosystem is being realised.

Our present knowledge on the beneficial effects of microorganisms in agricultural productivity is very limited and by fully exploiting the

hidden truth in this regard we can revolutionize agricultural productivity.

Blue Green Algae

10. Studies on Blue-green Algae of Rice Fields.

P. K. SINGH (Cuttack)

Effect of algal inoculation on growth and yield of paddy is being carried out at Central Rice Research Institute since last 12 years and it has been shown that increase in yield in equivalent to the application of 20 kg N/ha could be obtained with BGA under eyginertal conditions. However, many algal forms used to appear in both inoculated and uninoculated experimental fields. Further, fresh inoculation of blue-green algae grown in field conditions established frequently and mostly dried inoculum failed to come up. *Aulosira-fertilissima* grew well among other inoculated forms in our experimental fields. Water-logging, slightly acidic to alkaline pH, high temperature and full sun light were favourable for blue-green algal growth. Frequent rain with cloudy weather disturbed the establishment of inoculum. The dry weight and total nitrogen of *A. fertilissima* after 30 days of uniform mat formation in field were respectively 481 and 52 kg/ha/season.

Stock cultures of several blue-green algae of rice fields are maintained in laboratory. Two species of unicellular blue-green alga *Aphanothece* were reported for the first time as nitrogen fixer, especially under alkaline pH. The effects of various pesticides, herbicides and fertilizers were studied on growth and nitrogen fixing ability of several blue-green algae and it was found that they could tolerate their normally used concentrations. However, in general high fertilized fields contained less population of nitrogen fixing blue-green algae. The concentration of 10 ppm of NH_4Cl enhanced growth and nitrogen fixation of two algae.

There are various types of organisms which feed upon blue-green algae. The algal viruses were reported for the first time from hice fields and one of them was studied in deail. Genetical studies are also being carried out and several mutants with loss of nitrogen fixation were isolated. The experiments on transfer of *Nif* genes in non-fixing mutants and in rice plants are in progress.

11. Blue-green Algae—Key organisms in Increasing Agricultural Productivity.

R. N. Singh (Varanasi)

Among the many factors that could contribute to improving crop yields, increasing the availability of fixed nitrogen to crops is probably of the greatest importance. The recent scarcity of nitrogen fertilizers, the high energy requirement for their manufacture, and, most significantly, their increased cost have produced a tremendous interest in the search for alternative sources of N. This alternative can be realised through biological nitrogen fixation and more particularly through photosynthetic nitrogen-fixation by blue-green algae.

The blue-green algae are a unique group of photosynthetic nitrogen-fixing prokaryotes of undoubted antiquity. They are widespread in a great variety of environments, to which they often contribute a considerable amount of nitrogen. The importance of nitrogen fixation by blue-green algae in contributing to the fertility of rice-fields and in increasing crop yields is now generally recognized. However, their impact on other crops and under adverse soil and environmental conditions has not yet been fully realised. Blue-green algae play an important role in the reclamation of alkali, acid, saline and desert soils. In addition to the free-living forms, nitrogen fixing glue-green algae occur as symbionts in lichens, liverworts, ferns, cycads, and flowering plants and in situations where these host plants are abundant they add considerable fixed nitrogen.

Symbiotic Nitrogen Fixation

12. A critical appraisal of the utility of bacterial inoculants in increasing agricultural productivity.

N. S. Subba Rao (New Delhi)

The current situation regarding the high cost of systhetic fertilizers has necessitated a fresh look into the efficiency of bacterial inoculants as an inexpensive input to improve the yield of crops. Rhizobia and

Azotobacter containing inoculants are available together with rock phosphate mobilizing bacteria as new and vital ingredients to improve soil fertility. Results of experiments on these bacterial inoculants will be highlighted in the paper to be presented together with suggestions and measures to improve the quality of such inoculants available to the farming community.

13. Agronomic treatments and changes in the rhizosphere mycoflora of groundnut V. Effect of a weedicide 2, 4-D.

L. V. Gangawane and K. B. Deshpande (Aurangabad)

Soil treatment with 2, 4-D brings about changes in the mycoflora balance of groundnut *rhizosphere*. Fungal population decreased in rhizosphere upto 45 days while flowering and maturation period of plants was delayed by 15 days. However, number of individual species increased qualitatively both in rhizosphere and in soil. *Aspergillus fumigatus, A. carboranius, Cladosporium oxysporum, Rhizoctonia balaticola, Trichoderma lignorum* and *Helminthosporium halodes* were decreased considerably, while *A. terreus, A. nidulans, A. flavus, Fusarium semitectum, F. oxysporum, F. solani*, etc. were increased either in rhizosphere or in the soil or in both. Potential pathogens, *R. solani* and *Phytophthora rubra* were absent on the rhizoplane of plants raised in 2, 4-D treated plots.

14. Some Biological Characteristics of Nitrogen-fixing Cyanophytes in Relation to Rice Farming.

H. D. Kumar and J. K. Ladha (Varanasi)

The cyanophytes of paddy fields contribute to crop productivity by liberating nitrogenous and non-nitrogenous substances as extracellular products from young and healthy cells as well as upon death and decay of older cells. Nitrogen-fixing forms additionally contribute to productivity by fixing nitrogen which can then be assimilated by rice plants.

We have made several collections of natural populations of nitro-

gen-fixing cyanophytes from rice fields and other habitats with a view to comparing the nitrogen fixation potential of several clonal isolates of the same organism, *Nostoc linckia*. A comparative study of the relationships among growth, cellular and extracellular nitrogen content, and heterocyst frequency has been made for several clones of this alga. A significant correlation was observed between growth and cellular nitrogen content but no significant connection between heterocyst frequency and release of extracellular nitrogen could be detected. A comparison of total nitrogen contents of several subclones of a single clonal isolate failed to reveal any significant differences.

The significance of these findings in relation to rice farming will be discussed.

15. Nitrogen fixation and distribution in *Indigofera* and *Trigonella*.

Y. V. Rishi and S. B. David (Poona)

Under 'field' conditions best growth is obtained. This cannot be replicated even in pots containing field soil. Nodulation and nitrogen fixation seem to be correlated. *Indigofera* appears to fix greater quantity of nitrogen in the soil than *Trigonella*. In both *Indigofera* and *Trigonella* considerable nitrogen fixation occurs but the total nitrogen percent fixed by *Trigonella* exceeds that fixed by *Indigofera*.

16. Asymbiotic nitrogen fixing bacteria and their association with roots of higher plants.

P. N. Raju (Madras)

The occurrence of free-living nitrogen fixing bacteria in soils has been reported by many investigators. Asymbiotic nitrogen fixation in appreciable quantities explains the lack of plant response to added nitrogenous fertilizers in some soils, the recuperation of soils left fallow and the occurrence of large quantities of nitrogen in soils where legumes are not grown. The application of the sensitive acetylene reduction technique to the study of nitrogenase activity in microorganisms has

stimulated work on the contribution of these free-living N_2 fixing bacteria to the nitrogen economy of soils. Few of these bacteria are known to occur in large numbers around the roots of some plant species. Substantial nitrogenase activity in the rhizosphere of rice plants has been reported by Yoshida & Ancajas (1971). Associations of *Azotobacter paspali* with roots of *Paspalum notatum* and *Beijerinckia indica* with roots of sugar cane and many other grasses have been observed in tropical soils (Dobereiner *et al.*, 1972a, b). Occurrence of asymbiotic N_2 fixing bacteria in the root environment of corn and wheat has been reported by Raju *et al.* (1972). The importance of these associations in the nitrogen cycle and the characteristics of these bacteria concerned will be discussed here.

17. Nitrogen fixation by heterotrophic bacteria in flooded soils.

V. Rajaramamohan-Rao (Cuttack)

The contribution of bacterial nitrogen fixation to soil fertility has received inadequate attention, presumably because the efficiency of non-symbiotic nitrogen-fixing bacteria is not high (nitrogen fixed per unit carbohydrate utilized) and for a long time *Azotobacter* and *Clostridium* were the only generally recognized nitrogen-fixing species. Evaluation of potential values for nitrogen fixation in flooded soils has utmost significance in deducing the momentous role of non-symbiotic nitrogen fixers in these soils. By employing the sensitive methods like ^{15}N-analysis and acetylene reduction assay the potential nitrogen fixation values in rice fields have been investigated. Addition of rice straw to the surface layer of the soil greatly stimulated the activity of non-symbiotic nitrogen fixation. It has been estimated that incorporation of 1 g of rice straw to the soil under anaerobic conditions resulted in the fixation of 8—10 mg of atmospheric nitrogen. Facultative symbiotrophic and anaerobic nitrogen fixers were predominant throughout the growing period of rice. Maximum population density of these organisms occurred at flowering stage of rice plant. The addition of rice straw stimulated the populations of *Azotobacter* and anaerobic nitrogen fixers whereas applications of ammonium sulphate reduced their population density particularly during the early days of flooding. This inhibitory effect of ammonium sulphate on nitrogen-fixing populations was not pronounced when applied in combination with rice straw. The effect

of moisture, combined nitrogen and organic matter on the nitrogen fixing activity in rice soils has been investigated. Soil submergence accelerated nitrogen fixation ; a further increase in nitrogen fixation was noticed when the soil was incubated under argon atmosphere. Rice straw amendments to both moist and flooded soils enhanced nitrogen fixation.

Myscrorrhiza

18. Potentialities of vesicular arbuscular mycorrhiza for increasing crop yields.

DINESH KUMAR (New Delhi)

Endomycorrhiza of vesicular-arbuscular type, formed by species of *Endogoneceae,* occur on a number of economically important plants including most agricultural crops. There is evidence now that vesicular-arbuscular (VA) mycorrhiza can increase crop yield directly by boosting up the growth or indirectly by its beneficial effect on nodulation in legumes and antagonistic effect on soil borne plant pathogens. Increased growth of mycorrhizal plants, as compared to non-mycorrhizal ones, has been obtained in maize, strawberry, wheat, oats, tobacco, soybean, citrus, apple etc. In soybean, yield increases, due to *Endogone* mycorrihizae, was as much as 122%. Mycorrhizal maize seedlings had almost 12 times more grains per ear than non-mycorrhizal ones. Legumes, when inoculated with mycorrhizal fungi, showed better growth especially in phosphorus deficient soils.

VA endophytes increase the plant growth by (a) greater absorption of nutrients from the soil ; (b) increasing utilization of less available form of phosphorus such as rock phosphate, bonemeal and tri-calcium phosphate ; and (c) better utilization of applied phosphate. Since successful nodulation is known to depend on adequate phosphate supply mycorrhizal infections may also be playing an important role in nodulation and consequently growth of legumes.

These potentialities of VA mycorrhiza can be exploited with advantage in countries like India where soils are generally poor in phosphorus and fertilizers are in short supply. Unfortunately, practically no work is being done on agricultural crops, on these lines, anywhere

in India. Obviously, there is an urgent need to raise these studies to a level they deserve in this country.

Degradation of pesticides in Tropical soils

19. Degradation of pesticides in Tropical Soils.

G. Rangaswami (Coimbatore)

While we are required to apply increasing quantities of pesticides to combat the various macro and microorganisms which affect man, animal and plants, the ill-effects of the chemicals on the ecosystem leading to reduced productivity of all the blological systems are increasingly felt by the humanity. Several million tonnes of organics and inorganic chemicals with anti-microbial and insecticidal properties are added annually on to plants, soil and their environment, which while killing or inhibiting the harmful organisms, upsets the biological equilibrium.

The added pesticides finally reach the soil and water where they are subjected to attack by millions of microorganisms which possess varying capacities to breakdown the molecules. The activity of such organisms being generally more in tropical conditions than in the sub-tropical and temperate regions of the world, it has been found that in the South Indian soils most of the pesticides are degraded within a few weeks of application while a few persist for about 18 months. Several bacteria, fungi and actinomycetes which possess physiological properties to utilize the pesticide molecules as an energy and/or nutritional source for growth and multiplication have been isolated and their characters established.

20. Biodegradation of pesticides in Indian rice soils under flooded conditions.

N. Sethunathan, R. Siddaramappa, K. P. Rajaram, T. K. Siddarame Gowda and Sudhakar Barik (Cuttack)

Recent isotope studies at this Institute on the microbial degradation of pesticides in tropical Indian soils under flooded conditions are review-

ed with emphasis on commonly used insecticides in rice such as parathion (organophosphate), gamma and beta isomers of benzene hexachloride (BHC) and endrin (chlorinated hydrocarbons). Parathion degradation in flooded soils was largely microbiological and proceeded by nitro-group reduction to aminoparathion or by hydrolysis to *p*-nitrophenol and diethyl thiophosphoric acid. Biological hydrolysis of parathion appears to be more widespread, than hitherto beleived, as evident from the rapid biological hydrolysis of parathion in several Indian rice soils under flooded conditions particularly after repeated additions. The addition of rice straw to flooded soils enhanced nitrogroup reduction, but inhibited the biological hydrolysis. Gamma and beta isomers of BHC disappeared rapidly from laterite, allavial and pokkali (acid sulphate, saline) soils under flooded conditions principally by microbial action ; but these isomers persisted in sandy and kari (acid sulphate, saline) soils. The former three soils attained negative redox potentials (Eh) within 2 to 3 weeks after flooding whereas the latter two soils were in oxidized state even after 40 days of flooding. The data thus demonstrated a negative relationship between Eh and degradation of BHC isomers in flooded soils. Under flooded conditions, the potential accumulation of BHC isomers is limited in microbially active soils capable of attaining potentials of -40 to -100 mV within 2 weeks after flooding. Another chlorinated hydrocarbon, endrin, decomposed repidly in most soils except a sandy soil under flooded conditions. Endrin degradation proceeded by both chemical and biological processes ; but biological degradation was more complete with the formation of 6 metabolites in non-autoclaved soils as compared to only one compound of chemical reaction in autoclaved soils. These metabolites resisted further degradation under continued flooding and the use of endrin in rice would, therefore, pose problems of environmental pollution.

21. Dimethyldithiocarbamate Fungicides degradation by Microorganisms.

K. Raghu, N. B. K. Murthy and R. Kumarasamy (Bombay)

The dimethyldithiocarbamate fungicides like thiram and ziram the widely being used in India for the control of plant diseases. Tetramethylthiuram disulfide (thiram) is degraded by a *Pseudomonas* sp. There is an increase in the water soluble metabolites with the rapid disappearance of thiram in the medium inoculated with *Pseudomonas* sp and con-

taining thiram. The major product in water soluble metabolites is DDC-α-aminobutyric acid (DDC=dimethyldithiocarbamate). Besides this, dimethylamine and carbon disulfide are also produced.

Zinc dimethyldithiocarbamate (Ziram) is degraded by a bacterium. Interestingly the major degradation product is again DDC-α-aminobutyric acid. The significance of the above results in context to the biodegradation of these fungicides in the soil will be discussed.

Employment and income generation

Post-Harvest Technology

22. Modern Rice Milling Technology in India.

S. N. Banerjee and P. K. Kymal (New Delhi)

Paddy processing equipments used in the country has been mostly of traditional type consisting of metallic hullers and shellers in combination with paddy separators and cone-polishers. Even though in production of paddy India's position is second in the world, the milling technology was underproductive with the result that there was a considerable avoidable loss of edible rice.

The Government recognised that there was a vast potential for improving the entire post harvest technology including harvesting, threshing, cleaning, drying, storage, processing, packing and marketing so as to derive a higher milling recovery of rice. As a first step, a project was initiated for pilot study and evaluation to assess the potentiality of this approach. Seven modern rice mills imported from Germany and Japan were installed in seven rice growing districts of the country. An evaluation of these mills was undertaken by a Committee consisting of experts from different institutions/organisations concerned. The results indicated that while milling raw paddy the modern mills gave a higher outturn averaging 2.5% over sheller type mills and 6.6% over huller type mills. With parboiled paddy the higher outturn was 0.8% over sheller mills, and 1.6% over huller mills. Modern mills also yielded a better quality of rice with less brokens and a better quality of the by-product-bran. In the context of the world wide energy crisis the husk is also playing an important role in energy supply.

Encouraged with the results of evaluation the Government took up a programme for the modernisation of the rice milling industry in the country. Actions taken includes :—

(a) Development of modern rice milling equipment in the country in collaboration with foreign manufacturers ;

(b) Amending the Rice Milling Regulation Act and the Rules thereunder for the modernisation of the industry progressively ;

(c) Setting up of a Rice process Engineering Centre at the I.I.T. Kharagpur for training of engineers, technologists, rice mill operatives and manager ;

(d) Extension of the project through discussions, seminars, including international seminars ;

(e) Setting up of 24 modern rice mills by the Food Corporation of India.

(f) Setting up of modern rice mills in the Co-operative sector.

(g) Financial assistance by the nationalised banks to the industry for modernisation ;

(h) Assistance in development and evaluation of mini rice mills for replacement of single hullers ;

As a result of these measures more than 1000 rice mills have been modernised so far. There is yet a considerable unrealised potential for extension of the new technology to the yearly harvest of over 60 million tonnes of paddy which will yield an additional supply of one million tonnes of rice of better quality and 0.2 million tonnes of rice oil, besides husk as source of energy.

23. Post harvest technology problems in Cassava.

N. Hrishi (Trivandrum)

Cassava (*Manihot esculenta* Crantz), a traditional subsistence crop of low income group all over the humid tropics, is bulky, high in energy,

low in protein and deteriorable rapidly after harvesting unless processed. Its inheriant quality for drought tolerance, ability to grow on marginal soils and its relative resistance to weeds and pests makes it all the more easy for cultivation in many areas. Added to these qualities it can be left in the ground without harvesting for a longer periods, which makes it a more suitable crop as a security against famine. Because of its extreme perishable nature losses after harvesting are substantial. There are currently three methods used in the country for preserving harvested cassava. (1) by coating fresh tubers with mud (2) by chipping and sun drying the whole tubers (3) by sundrying parboiled chips. None of these methods appears to be very efficient nor or the technique standardised in terms of chip size, shape, etc. Information is also lacking on the magnitude of the problems of the processing industry. There appears to be considerable scope for improving both processing and drying techniques by just obtaining a better understanding of the methods currently in use and then by assessing the applicability in our country of techniques currently used in other countries. Similarly techniques and gadgets are to be evolved for harvesting so that the shelf life of the fresh tubers can be enhanced. The utilization of cassava is now limited to direct cooking of the tubers and also extraction of starch by small and medium size industries. Since cassava starch forms a basic raw material for food, feed as well as for innumerable industries, post harvest technology needs much emphazis in order to utilise the cassava both for consumption and for export to earn valuable foreign exchange.

24. Time of harvest and milling recovery in rice.

S. Govindaswami (Shillong)

Rice is harvested on the 40th or 45th day after flowering according to the convenience of the cultivator. This practice reduces both the head rice and total milling out turn apart from other losses such as shattering, rodents etc. Developmental studies indicate that biological maturity of the grain is reached 21 to 23 days after flowering and grain fiilling continues for 5 to 7 days after that period. Harvesting trials conducted on early, medium and late varieties had indicated that 25 to 33 days in the case of early and medium varieties (*Bala, Krishna, Cauvery, Jaya, Ratna,* etc.) and between 27 to 39 days for late varieties (*IR.* 20, *Pankaj, CR.* 1014, etc.), seems to be the appropriate time for harvest for

getting best head rice and total milling out-turn. The moisture content at this stage is high (18 to 23%) and shade drying or artificial drying has been found more suitable than sun drying. Sun crack formations in the grains occur mostly due to intermittent wetting and drying of grains at the critical moisture level of 16 to 18% during drying in fields at which stage grains are hygroscopic. Harvesting and removal of crops from the field before this critical period will eliminate sun crack formation and can give better quality rice. This is an easy method which a common cultivator can follow with great advantage.

25. Effect of salt spray on drying and milling outturn of rice.

H. K. Pande and G. C. Pande (Kharagpur)

Field experiment was conducted during July-November (Khariff) 1974 at the Indian Institute of Technology, Kharagpur, West Bengal to study the physiological maturity of rice and effect of salt spray on drying and milling outturn of rice variety "Jaya". The crop was sprayed with 10 and 20 percent salt solution (Nacl) on 8 different dates leaving each time a plot unsprayed for comparison. The salt spraying was commenced from 16th day after flowering on each alternate days and continued upto 30th day. Observation on grain yield, moisture content and milling quality were recorded. For milling samples were taken from the treatments where the yield was comparable i.e. of 24th, 26th, 28th and 30th days after flowering.

The data revealed that the optimum yield was obtained when the crop was harvested 24 days after flowering. Harvesting the crop prior to this period resulted in significant reduction in grain yield. The crop yields were at par when crop was harvested between 24th and 30th day after flowering. Further, harvesting the crop beyond 30th day after flowering resulted in decreased grain yield. The moisture content of grain was reduced considerably by salt spraying without affecting the total grain yield. In case of the crop treated with 10 and 20 percent salt solution on 22nd day and harvested on 24th day, the moisture content was decreased to 16.4 and 16.2 percent respectively as against the unsprayed crop which estimated 26% of grain moisture.

Regarding the milling quality of rice, there was no appreciable difference in total rice yield (Head rice + Broken) among the different

treatments. However, salt spray treatment at both the levels caused higher broken percentage as compared to unsprayed treatment resulting in low head rice yield. Further, among the two salt concentrations 10 percent salt spray brought less broken percentage. Harvesting the crop 24 to 30th day after flowering under unsprayed treatment brought almost an equal outturn of percentage head rice.

26. Harvesting and Drying of high moisture paddy and their effect on field yield and milling yield.

P. K. Chattopadhyay and S. P. Bose (Kharagpur)

To reap a greater harvest by minimizing the shattering loss and also for adopting multiple cropping early harvest to release the land appears to be an essential necessity. Proper drying of paddy harvested at high moisture content also results in higher milling yield.

A detail study was conducted in the different farmer's fields and State Seed Farms situated in Burdwan and Midnapore districts of West Bengal with the objectives (i) to estimate the effect of various grain moisture levels at harvest on field yield and milling yield of paddy, (ii) to evaluate the effects of different methods of drying, and (iii) to specify the time of harvest interms of number of days after flowering.

For carrving out the study four varieties of paddy viz., Jaya, Ratna, Pankaj and IR-20 were selected. Harvesting and drying operations were performed during May 1972 to January 1973 to investigate the response of the crops of Boro, Aus and Aman seasons. Each season crop was harvested between 25 to 55 days after flowering having four ranges of grain moisture contents viz., high ($26\% > m.c \geq 22.5\%$), medium ($22.5\% > m.c. \geq 19.5\%$) low ($19.5 > m.c. \geq 16.5\%$) and controlled ($16.5\% > m.c. \geq 14\%$) with three replications of each moisture range. Two methods of drying viz., mechanical drying and sun drying were performed.

Results show that grains attain physiological maturity within about 27 days after flowering. Paddy harvested at this period with high moisture content around 23 percent (wet basis) gives 2 to 4 q/ha more field yield, 1 to 2 percent more total milling yield and 5 to 7 percent more head yield than the paddy harvested at lowest moisture content of

14 percent (wet basis). Mechanically dried paddy gives 1 to 2 percent more total milling yield and 2 to 4 percent more head yield as compared to sun dried paddy. All the data obtained for the field yield and milling yield varied with the varieties of paddy tested. The optimum time of harvest of paddy is within 27th to 29th day after flowering when the grain moisture content varies between 25 to 22.5 percent (wet basis).

27. Development of post harvest technology for grapes in India—Production of wines.

P. TAURO AND M. C. BARDIA (Hissar)

In the State of Haryana, the acrage under grape cultivation is around 1000 acres with a production of 7-8000 tons of grapes. Unfortunately, the varieties grown are all table varieties and the crop is available for a very short period during the hottest part of summer. In view of this, the Department of Microbiology at the Haryana Agricultural University embarked on examining the feasibility of using the available grapes for production of table wines. A large number of varieties grown commercially as well as under experimentation have been screened for wine production and the conditions for the production of wines from a few selected varieties have been developed. One table variety of grape namely Pearlette has been successfully used for wine production on a large scale in an experimental winery. Thus it has been possible to demonstrate that table varieties of grapes grown in the northern region of India can be successfully used for the production of acceptable quality of table wines and this holds a future for the grape growers of this region.

28. A Scientific Approach to Problems of Post Harvest Technology for Integrated Development.

C. P. GUPTA (Kharagpur)

Post harvest technology involves the application of engineering and scientific knowledge to operations such as harvesting, threshing, cleaning,

drying, milling, grading, weighing, storing, handling, transportation, markting and distribution. It may also involve certain other operations for specific crops. Technology for utilization of by-products for processing industry also falls in the domain of post harvest technology.

Usually the problems of post harvest technology involve the design, development and testing of some new machine and structure or improvement in existing machine and structure, evolution of a new process of modification of existing process to suit local needs ; planning and layout of some new processing plant and structure or improvement in existing processing plant and structure.

There should be a scientific and systematic approach to identifying problems, assignment of these problems to various organisations and institutions for their solution and transferring these solutions or results of research to farmers and industrialists who are the ultimate users of this post harvest technology.

This paper lists some of problems related to post harvest technology of cereals, pulses, oilseeds, fibres, fruits, vegetables nuts, spices and other crops such as sugar cane, tea, coffee etc. In identification of problems, farmers, industrialists, planners, and researchers of post harvest technology and allied fields should be involved. A comprehensive review of what has been achieved should be made and future problems which should be tackled on priority basis should be listed. A survey of research facilities at various institutions and organisations should be carried out. The centres of research for post harvest technology of one or more crop grown in that region should be established.

Solution of problems of post harvest technology requires the coordi nated effort of multidisciplinary team of agricultural engineers, food technologists, biochemists food-nutrition specialists, system engineers, mathematicians, statisticians and computer technologists and other specialists depending upon the nature of the problem. Therefore working of multidisciplinary team at these research centers should be encouraged.

Finally there should be a well organised agency to transfer results of research in post harvest technology to farmers and industrialists in a language well understood by them. Due to practically non-functioning of this vital mechanism, the true impact of post harvest technology on rural development has not been felt.

It is hoped that suggested scientific approach in the field of post harvest technology will lead to integrated rural development if it is properly planned and executed.

29. Role of moisture in the post harvest storage of wheat grains and its milled products.

S. S. Arya, D. B. Parihar and H. Nath (Mysore)

Moisture, temperature and oxygen availability are the three major factors which influence the rate of deterioration during storage of food-grains and their milled products. Even though the effect of these factors is interdependent, under practical conditions of storage and transport, moisture content mainly determines the useful shelf life of wheat grains during post harvest storage and its subsequent utilization into milled products.

The amount of available moisture or the interspace humidity is the most important condition that determines the growth of microoganisms in the stored grains and milled products. Wheat grains and its milled products normally have interspace relative humidity of less than 85%. The minimum humidity requirements for various moulds and fungi for their growth are above 65% and therefore the moisture content in the grains should be below the level at which these will equilibreate to 65-70% RH for their safe storage.

The chemical changes taking place during post harvest storage of wheat and during subsequent storage of its milled products are mainly governed by moisture and temperature of storage. Below 8% moisture intact grains can be stored for long periods without appreciable changes but storage of milled products is associated with oxidation of lipids and bleaching of carotenoids and xanthophyls. Above 8% moisture there is slow lipolysis of wheat lipids resulting in the accumulation of free fatty acids. Above 14% moisture in intact grains and 12% moisture in "atta" mould growth ensues resulting in the decreased amounts of total lipids especially in polar lipids which influence its functional utilization.

The changes in sugars and proteins are also governed by the amount of moisture. Below 12% moisture gliadin and glutenin remain unchanged but amount of salt soluble proteins decrease. About 12% moisture both glutenin and salt soluble proteins decrease resulting in decreased water absorption and extensibility of the dough which affect the chapati or bread backing potential. At higher moisture levels, non-reducing sugars are converted into reducing sugars mainly by enzymes released by the growing moulds. Since the growing fungi, metabolize sugars, the concentration of total sugars decreases during storage.

Wheat and atta stored at moisture content higher than 12% have been found to give chapaties harder in texture and poor puffing characteristics. Role of certain polyethylene laminated bags for storage and transportation of milled wheat products has been found to be helpful in minimising the moisture ingress under tropical conditions.

30. Post-harvest technology.

P. V. Surya Prakasa Rao (Hyderabad)

The farmer is now at the mercy of weather even for such a simple but vital post-harvest operation like drying his produce.

Without proper drying, the produce could deteriorate fast in quality and lose in value as a result of germination, microbial or insect infcestation. Inadequate drying could lead to lower milling yield or give rise to difficulties in milling and processing.

Improved tools and equipment, reflecting the many advances in modern science and technology, are not yet generally available to the farmer at the farm or village level, particularly for the following operations : drying, threshing, curing, cleaning, grading, disinfesting, treating, packing and storing the produce.

Disseminating information on scientific post-harvest handling of agricultural crops and commodities and provision of modern tools and technological aids are extremely important for conservation of agricultural supplies, and prevention of qualitative deterioration and spoilage losses which sometimes exceed the shortfalls in national production.

The technology of controlled flue-curing of Virginia tobacco permeated quickly to the farmers' level because of the adoption of the right methods of extension, that is, by simplification of technology to levels which could be understood by the farmers and of tools which could be purchased/fabricated and used by them without difficulty. Intensive and extensive application of similar methods, and imaginative techniques and tools are called for to carry the many benefits of modern science and technology to the very door-steps of the farmer.

There is need to identify, rationalize and streamline sound traditional methods of post-harvest handling and treatment of agricultural

crops which have stood the tests of time and clime, and to encourage the adoption of these on a wide scale by the farming community.

Agro-industrial complexes and other rural industries

31. Agricultural Marketing.

S. V. PINGALE (New Delhi)

Appropriate price for the produce is the most important in put for agricultural production. Industries have highly developed strategies for marketing and getting the required incentives for production. Agriculturists has no time and resources for deciding the strategies. This task is therefore, assumed by the middleman who tends to work more for his profits than for the interest of the agriculturist. The need for markets for agriculturists which will ensure the producer his dues is to be seen in this context.

Concept of a regulated market for agricultural produce is not new. What is however, to be considered from a scientific view point is how these markets can serve the agriculturists to be maximum. In this connection distance at which the markets be set up, area of the market, layout plan and the facilities to be provided assume significance. Presently two categories of markets are developed in the country namely, one in which the Market Committee owns everything and the other in which facilities are owned by the Committee and others. Though sizeable fees are collected facilities available are not commensurate. In the absenee of facilities and guidance to agriculturists, produce that is not clean, well dried and graded results in eating up of national resources apart from not yielding appropriate return to the producer. Agricultural marketing is still left much to the middleman who in his own interest would like agelongs methods to continue. High yielding varieties need some changes in the traditional approach to the marketing and this is possible when marketing gets re-oriented quickly. Regulated market is also the place where agriculturist gets a peed into developments talked about and gets an opportunity to exchange thoughts with others. A market that is well organised can, therefore, give much more than the price of the produce to the agriculturist. In return nation gets better quality produce in increasing quantities. The magnitude

of this 'give and take' will depend upon the extent to which scientific concept of marketing is applied to these agricultural markets.

32. Sheep and goat farming as a rural industry.

Major G. S. Bali (Mysore)

The paper will be presented mainly from the point of view of emphasising the need for sheep and goat farming and industries based these viz., supply of quality meat, utilization of slaughter house by-products, leather industry, their present status and suggestions to improve the existing conditions. The topics will be discussed broadly under the following headings :

(1) Raw material. In the most affluent countries "meat" has been organised into well established industry. Today meat is America's third largest industry next to steel and automobiles. We are second largest live stock holder in the world and our animal population is double that of U.S.A. Still the availability of animals is limited and shortage is felt all over the country. NCST Panel on Consumer Industries have projected a requirement of 350,000 tons of meat from sheep and goat by 1979-80. To achieve this target concerted and earnest efforts by Central, State and all the affiliated agencies will only help in production of quality mutton and raw material for ancillary industries.

(2) Marketing and Transportation. About 513 million kgs. of meat is processed in the country annually. By and large all the animals slaughtered for the purpose come from farmers who had reared them in remote villages. The channels through which these animals passed are tedious, middleman involved make it un-economic, transportation system employed are far from satisfactory.

(3) Specifications and Ante and Post Mortem Inspections. A thorough examination should be made of the existing conditions and specifications laid down for acceptance of animals for slaughter. In the chain of producing quality mutton slaughtering of animals, ante mortem and post mortem inspection should be streamlined.

(4) Slaughter houses. The facility of slaughtering these animals at least at district level under a common roof will help to improve quality, effective utilization of slaughter house by-products and disposal of skins for leather industry.

(5) Leather industry. We export leather worth Rs. 200 crores annually. The figure can be trebled if productions of skins are more and existing semi processed exports are converted into finished goods.

The development of sheep and goat farms will effect rural development, more employment, better utilization of manpower and economic gains to the country.

A comprehensive scheme will be presented to imply the idea of sheep and goat farming in rural areas with the help of agencies like Corporations, Banks, Block Development Officers, Agricultural or Research Institutions engaged in one way or the other to this branch of science.

33. Integrated area development through the establishment of Agro-industrial complex 1

S. P. Bose and H. K. Pande (Kharagpur)

Rapid transformation of subsistence agriculture to a commercial one is considered essential for achieving integrated area development. The establishment of farm-firm industries, input industries and agro-based industries comprising an areawise Agro-Industrial Complex can bring the desired level of commercialization in fulfilling the above-mentioned objective.

Willing participation of the farming community in the area development programme would be forth coming only when an atmosphere of social sanctity is made to prevail through the co-ordination of government, semi-government and private agencies by establishing agro-industrial complex. Farmers can receive effective technical and managerial assistance from agro-industrial complex for solving their multi-directional problems within a shortest possible time period.

Studies on economics of resource use under different categories of land holdings have indicated that use of HYV seeds, cash inputs and crop yields are closely related with farm size, all being higher on large farms. Small farms received meagre quanta of credit and physical inputs. Enhancing the availability of credit and inputs for farmers has proved to be the most important step in increasing agricultural pro-

duction. It has also been observed that individual managerial ability of farmers does play a significant role in the relative usefulness of different resources.

Patterns of multiple-cropping studied under differential conditions of land and irrigation have depicted the importance of agro-industrial complex under the existing categories of land holdings in our country. Areawise desired level of initial investment has been assessed. On an average the estimated initial requirement of space, equipment, material and personnel in terms of money comes to about Rs. 43 millions per 5000 hectares cropped area studied. The componentwise break-up of the initial investment is as follows :—(1) Agro-Service Centres Comprising of a Custom-Hire Units for equipments and mechinaries, (b) Fertilizer Units, (c) Plant Protection Units and (d) Seed Units would require 70 ; (2) Agro-based Industrial Centres comprising of (a) Modern Rice 70% ; (2) Agro-based Industrial Centres comprising of (a) Modern Rice Milling Units, (b) By-product Utilization Units, (c) Crop processing Units (other than rice) and (d) Vegetable Processing Units would require 25% ; and (3) Storage Units for Agricultural produce (particularly for potato) would require 5%.

34. A possible processed food rural industry.

K. T. Achaya (Bombay)

Numerous surveys of dietary patterns in India have shown that perhaps the weakest nutritional point in life occurs at about the age of 6 months. The volume of mother's milk is insufficient in quantity and nutrient composition to meet the needs of the growing child and yet, by tradition, no supplementary foods are given till the child can "walk-and-talk". It is only after the age of about 3 that the child is able to claim its share of food, and much damage has already been done. Indeed several studies have shown that supplementary weaning food given during this period confer decided nutritional benefits.

Ideally, mothers should be educated into meeting this need from their own kitchens, but this is a mammoth task with formidable logistics. There may be a better practical possibility of meeting the need of weaning food through traditional food processors who already exist even in villages, *viz.* the small units who roast, pound and grind food

materials. Even a marginal profit may be a sufficient inducement to such units to make roasted and ground mixes consisting of local cereals or millets, grams or pulses, and oilseeds in certain simple proportions, such as 4 : 2 : 1, so as to result in mixtures of adequate protein content for use as a children's food.

Having these ground mixtures sold from ration and fair-price shops would have several advantages. Price control can be exercised. Promotional efforts can be narrowed just to these points, so that demand can be built up from mothers coming to these shops for their rations. At the same time, the staff working on nutrition and health programmes could be integrated into the effort by obliging them to draw the attention of mothers to these food mixtures available at the ration shops. These ideas will be developed in the paper.

35. Agro industrial complexes and rural industries.

P. V. Suryaprakasa Rao (Hyderabad)

Agriculture and industry had been very well integrated as long as they were home-and village-oriented in the traditional but now decadent farmer-cum-artisan-centred Indian economy. Gradually, however, industry became divorced from agriculture over the years, after the advent of the modern urban-oriented industrialisation giving rise to the many ills that are plaguing the industrial economy of the present day, such as over-congestion, imbalance in development, profiteering by the middlemen, rising costs and prices, under-utilization of capacity, uneconomic use and under-exploitation of resources, neglect of by-products industries, unemployment among large segments of population, both educated and uneducated, and a host of others.

The philosophy behind the modern concept of agro-industries is integrating, coordinating and liaising industry with agriculture for planned, harmonious and balanced growth and development of the two, encompassing all the operations from primary production to the marketing of ultimate products, fresh and processed, including by-products.

This concept of vertically integrated agro-industries has gained rapid recognition and great popularity in several countries during the last few years. Agro-industries built around this concept of integration have brought about a mutually enhancing or 'synergistic effect by the

interaction of agriculture on industry and vice-versa, accompanied by a boost in the productivity and economy of agriculture and industry alike.

Following are some of the important goals and likely benefits of development of agro-based industries conceived on the above lines :—

(1) Increasing the productivity of agriculture and farming by modern methods of scientific management and intensive production, optimising the productivity of land, and the men and animals living off it.

(2) Stabilizing the prices and supplies of agricultural produce and farm products thro' time and space.

(3) Ensuring reasonable returns to the producers and processors and fair prices to the consumers, avoiding intermediaries as far as possible.

(4) Conserving food and agricultural supplies and avoidance of wastage and loss by means of modern, scientific methods of handling, storing, processing, preserving, packaging and marketing.

(5) Promoting rational, integrated and total utilisation of agricultural crops including crop residues, wastes, etc., creating new, useful products and additional wealth.

(6) Relieving under-and un-employment by creating additional opportunities for employment in agro-allied industries.

(7) Improving the incomes and living standards of people, more especially in the rural areas and among the farming communities.

(8) Improving the nutritional standards of men and animals by rational, scientific processing and formulation of foods and feeds.

Integrated Agro-industrial complexes are pre-eminently suited for

— new settlements meant for rehabilitating weaker sections of the population, refugees, repatriates and destitutes, the unemployed educated and uneducated.

— development of export-oriented agro-industries.

— development and colonisation of hitherto uninhabited, inaccessible, undeveloped, and under-developed areas.

— development of vocational or employment-oriented education centres,

— helping in the dispersal of industries in the rural and industrially backward regions.

— spreading prosperiey among large rural and backward communities and areas.

Properly conceived, carefully planned and imaginatively implemented, they could be an answer to the problems of mass unemployment, backwardness and under development of rural areas, regional imbalance in industrial development, congestion and pollution around metropolitan cities and large urban industrial complexes.

III. SEED PRODUCTION, DISTRIBUTION AND TESTING

1. Seed production industry—The basic element for accelerated agricultural development.

M. V. N. Setty (Bangalore)

Good to excellent breeding programmes have been established in most of the countries. As a consequence, a good lot of high yielding varieties and hybrids have been developed in certain field crops. New and improved crop varieties, however, become a significant agricultural input only when pure, high quality seed are available to and planted by cultivators. The justification and mission of a seed program are, therefore, extension of superior varietal performance demonstrated in test plots to all crop lands where the variety is adapted. This is best accomplished by means of an organized systematic and co-operative effort, institutions and personnel—a seed industry.

A sound seed program-industry serves as a strategic element for accelerated agricultural development through the following benefits. Increase in yield through high yielding varieties and hybrids. Increase in recoverable yield due to more uniform maturity. Increase in yield resulting from high physiological quality (vigour) seed. More effective utilization of fertilization, irrigation and pesticides, because of uniform emergence and growth and better stands. Reduction in planting rate.

Despite the full realization of the strategic role of seed program—industry in accelarated Agricultural Development, hardly a few countries have succeeded in organizing an effective seed program industry.

The most serious impediment to establish a good seed program-industry in the less developed countries, is an inadequate and/or incomplete understanding of just, what a seed program is and what it is not.

2. Rapid methods of testing seeds for viability.

O. P. Saxena (Ahmedabad)

International Seed Testing Association aims at evolving rapid methods for seed evaluation for viability. Tetrazolium and X-ray methods are now being generally used. Tetrazolium technology is too complicated and requires great expertise and it is also difficult to interpret results in case of minute seeds while X-ray unit is not available everywhere and hence there is need to develop routine, simple, reproducible and rapid biochemical and biophysical methods for testing seeds for viability. Peroxidase and its isozyme are well known to play important roles in juvenile differentiation. Based on benzidine and guaiacol a method has been developed which can decide viability of the seeds within ten minutes. Similarly isozyme of peroxidase can be localized in the seeds within thirty minutes using o-dinitrobenzene. Electroconductivity measurements of the seed leachates within one hour also give quite good information on viability status of the seeds. Data will be discussed in the light of work of other researchers.

3. Economics of Deccan hybird maize seed production in Karnataka state.

R. Ramanna, M. V. N. Setty and K. G. Mallikarjunaiah (Bangalore)

An investigation into some aspects of Deccan hybrid seed production was conducted in Bangalore-Kolar Seed Production Belt during summer season of 1973-74 The sample comprised of 38 randomly selected farmers. All the farmers produced seed under growers' programme (entering into fixed selling price contract) and hence did not experience any marketing problems. The major risks experienced in seed production were the damage by stray cattle/birds (82.05%) and attack by pests and diseases (38.46%).

The average per acre yield of qualified seed was 723 kg with a range of 300 to 1,467 kg. The average yield of male seed, disqualified seed and straw were 306 kg, 102 kg and 2,500 kg, respectively. The