New Kekulam rice cultivation:
a practical and scientific ecological approach

Paddy farmers in Sri Lanka face serious problems. In conventional rice cultivation inputs are expensive and yields are low. Although new improved rice varieties have a potential return of over three tons per acre, in reality they often yield less than one and half tons. This production level reflects a history of indiscriminate agro chemical application and the effects of soil erosion caused by inappropriate land preparation techniques. This article explores a way of mitigating the potentially disastrous consequences of this process.

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After a detailed study of the problems associated with conventional rice cultivation, the Eco-Conservation Organisation (ECO) developed the new Kekulam method of rice growing.

'Kekulam' means the sowing of paddy seed that has not been pre-germinated and the new approach seeks to combine farmers' experiences with concepts drawn from modern farming such as mulching wetland rice, using weeds as crop protection agents, and carefully avoiding normal weed control measures and agro-chemicals.

Mulch in the new Kekulam system reduces erosion to near zero and has the added benefit of improving soil properties and reducing both the incidence of weeds and the amount of tillage required. Farmers, supported by ECO, found that the system was 75% cheaper, more time efficient than conventional rice cultivation and achieved water savings of up to 50%. This helped to offset the negative effects of climatic irregularities. In ecological terms the system leads to a substantial improvement in fauna and flora bio-diversity. In the earliest stages of cultivation, rice grown by the new Kekulam method requires no pest or disease management measures and whilst yields may be 10% less than conventionally cultivated rice in the first one or two seasons, they subsequently rise to a similar level.

Weeds on bunds

In conventional rice cultivation, weeds are normally removed from bunds and thrown into the fields. In Kekulam cultivation, however, weeds are left on the bunds to harbour predators. Whilst there may be some harmful insects amongst these predators, their numbers are relatively small and can be kept under control. Weeds that grow on bunds are slashed and laid on the bunds when they become taller than the rice crop itself.

Not puddling but mulching

In Kekulam cultivation, the soil is loosened with a country plough, a mommoty (flat-bladed hoe) or a tractor-drawn tyne cultivator. Ploughing and other forms of soil turning are avoided. A rotovator can be used if no tyne cultivator is available but should never be used to cultivate below a depth of five centimetres. Kekulam cultivation requires a cloddy soil and not the fine surface usually associated with conventional rice cultivation. If rains are expected within a few days of sowing, mommoties are used to construct shallow drains to carry away excess water. This is all the land preparation required.

Experience has shown that rice varieties that mature within four or more months are the most suitable for Kekulam cultivation. Seed is broadcast on dry land if rain has fallen or the land is wet from irrigation. Sprouted seeds are sown broadcast. Once the field has been sown, it is covered with a mulch made either from rice straw gathered the previous season or, if this is not available, with green leaves, dried grass or branches and twigs. It is not necessary to apply fertiliser if the fertility level of the land has been built up to an appropriate level.

A manure-fertiliser-neem mixture

Only very small amounts of nitrogen fertiliser are applied. A manure-fertiliser-neem mixture provides the basis for soil fertility management. It can be prepared in the following way. Powder 1-2 kg neem seeds and add them to 7 kg urea. Powder this mixture again, mixing it well with at least 50 kg of well-rotted, fine compost. Whenever possible, use more than 50 kg of compost. The mixture of neem seeds, urea and compost should be gathered into a heap, covered with polythene or sacks, and kept for no longer than 12 hours before being spread on the fields. Preferably the mixture should be made in the morning and applied at sunset, thus allowing the insect repellent and manuring properties of the neem seed to be used to full advantage. The manure-fertiliser-neem mixture should be applied 10 to 12 days after the seedlings emerge and a second application should be made 10 days later. Before any subsequent application is made, the crop should be observed carefully. If there are yellow leaves indicating nitrogen deficiency, a third application should be made fifteen days later. Normally a fourth application is only necessary when soils are very infertile or when varieties that take longer to mature are grown. The number of fertiliser applications needed decrease when the Kekulam system has been in use for several seasons.

Effective micro-organisms (EM)

Direct feeding to soil microbes rather than the rice itself will fix sufficient nitrogen and make other essential nutrients available once microbes are established. In Sri Lanka experience has shown that it is possible to bring the soil into balance again within four to five seasons by using composts and neem seeds. In infertile soils, the extraction of soil nitrogen by microbes decomposing mulch and other organic matter causes seedlings to yellow in the early stages of growth. An EM (Effective Micro-organism) solution or home-made liquid manure (see Box) can be applied to overcome adverse effects and retarded crop growth. It can also be applied

when a thicker than normal layer of mulch is being used. The EM solution is a combination of different beneficial and coexisting soil micro-organisms and was developed in Japan by Professor Higa. It is currently being used in many countries.

No weeding

In Kekulam cultivation, mulch is used to keep the weed population to a minimum and it becomes unnecessary to remove the few weeds that do appear because these will act as host plants to predators. The weeds of the *Echinochloa* species, however, must be removed and this can be done by hand because of the small numbers involved. There are two or three varieties of weeds - members of the grass family - that germinate with the rice and absorb nutrients faster than the rice plant itself. Kekulam farmers sow rice at higher densities than in conventional cultivation in order to smother weeds. The mulch, the manure-fertiliser-neem seed mixture and a high seed density keep weed populations at a level that favours bio-diversity in both fauna and flora.

No pesticide application

In conventional agriculture, weeds, harmful insects and diseases are treated as pests. In ecological farming and Kekulam cultivation, they are treated as a natural resource. No chemical pesticides are used and plant-based pesticides are only applied during the initial stages of conversion when harmful insects, disease-causing organisms and pernicious weeds still dominate. Kekulam farmers try to establish a balance between all organisms as quickly as possible by improving bio-diversity and avoiding activities that might harm any form of visible or invisible life. The proportion of harmful organisms can gradually be reduced over time if there is a balanced natural supply of plant nutrients from organic matter, host plants are provided for predators, and the diversity of soil microbes is increased as a result of protective measures. Avoiding the use of excessively nitrogenous fertiliser also helps reduce the incidence of pests and diseases. Climate changes, variable weather and mistakes by farmers can cause an upsurge of pests and disease. In such situations a kem (a traditional rite) which does not damage the eco-system, is carried out. Sometimes a plant extract from neem seed preparation or *Derris* scandence stems is used. Kekulam farmers, however, never use chemical insecticide.

One might think that a Kekulam farm, surrounded by conventional, high-external-input farms, would be vulnerable to diseases and pests. This is not the case. I have personally observed two small beds on a conventional farm being cultivated using Kekulam farming techniques: these beds remained free of pests and disease even though the rest of the farm was affected.

Mulching

Kekulam cultivation had been practised in the past but, with the emphasis on irrigated rice cultivation, its significance declined. The most significant difference between the two systems is mulch and the way it is used. Mulching allows straw to be recycled very simply. The mulch protects the soil from erosion and improves its physical, chemical and biological properties. The effect of mulch is something that has to be experienced: it cannot be explained. Improvements to fertility exceed expectations probably because of the combined effect of soil conservation, nutrient enrichment, enhancement of biological activities and the improvement of moisture-retention capacity. Weed suppression also contributes to yield improvement. Mulching increases the soil's moisture retention capacity at the beginning of cultivation providing cover for seeds and helping to ensure uniform germination. In conventional rice cultivation intensive land preparation is an essential factor: it keeps fields weed free and encourages a good plant stand. Perfect levelling ensures a uniform depth of water which checks weed germination and growth. In the Kekulam system, mulch helps keep weeds down to an optimum level, encourages moisture retention without perfect levelling, and protects nutrients from being leached out. The Kekulam farmer does not have to till his or her fields so intensively and can keep manure and fertiliser use to the minimum.

Maximising water use

At the national level, using Kekulam cultivation can reduce the amount of irrigation water required by as much as 50% - a great leap forward in improving irrigation efficiency. At present farmers are often restricted to planting small areas because there is not enough water in the reservoirs to allow them to cultivate more extensively. Using the new Kekulam method it may sometimes be possible to cultivate all the land available and still use only half the amount of water normally required. At the moment cultivation takes place when there is sufficient water in the reservoirs. Quite often the season is delayed and this can lead to pest damage. These delays can be avoided if the Kekulam method is used and water is saved. The increase in the area available for potential cultivation can be of tremendous national significance. A 25% extension can have the same effect as constructing reservoirs with 25% of the capacity of those currently in use. The Kekulam method is particularly important because often the number of suitable reservoir sites is limited and water is always in short supply.

Lower inputs, savings in labour and reasonably high yields even with a limited supply of water mean higher profits and demonstrate that the new Kekulam method is not only viable but also economically sound, environmentally friendly and gives sustainable yields. It is a valuable, alternative, cultivation method and as such warrants further research and popularisation. ■

Home-made liquid manure

Liquid manure acts not only as a manure but also as a foliar spray, mild fungicide and mild insecticide. It has the properties of plant-growth hormones and enhances soil life. In addition to all these effects it appears that crops treated with this liquid manure also develop resistance to viral diseases. As a nutrient source the liquid manure is complete and balances macro, micro and organic compounds. It can also be used as a catalyst to promote growth. When used regularly in sufficient quantities no other manures are required. The use of liquid manure is a way of maximising the utilisation of available nutrients. Crops respond well to liquid manure even on soils poisoned and inactivated by excessive use or agrochemicals. When applied to starved crops, the visual effect of application is clear within 24 hours.

Preparation

To prepare the liquid manure, sheep, goat, pig or cattle dung should be mixed with water and fresh leaves of the Gliricidia or any leguminous trees. An equivalent to 10% of the wet weight of the dung required should be added to the mixure. The fresh dung should be mixed with water in a tank or a barrel and the fresh leaves dipped in the dung mixture. The leaves selected ought to be those that dissolve when dipped. Leguminous leaves are preferred because of their high nitrogen content. In Sri Lanka the best species were found to be 'keppitiya' (*Croton lactifer*) and 'hinguru' (*Lantana camara*). The mixture should be churned daily. After about eight days a pungent odour will develop so it is better to keep the tank or barrel well away from dwellings. The vessel should also be covered to avoid mosquito breeding. Gas bubbles will appear as decomposition begins. After about three weeks the manure is ready and a layer of foam appears on the surface of the mixture.

Use

When using this manure add one volume of the concentrated liquid to 3 to 4 volumes of water. High value crops are sprayed at a rate of about one litre per square meter, depending on the crop and growth stage. The liquid manure can also be applied to the soil. When paddy is being cultivated, the manure can be mixed with the irrigation water. If the treatment is carried out weekly, excellent results can be expected.

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