# Strategies to Optimise Tuber Crops Based Cropping Patterns in Tribal Areas to Ensure Livelihood Security

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## Abstract

The celebrated Kerala model of development has not made much change for the socio economic life of the marginalized sections of Kerala. The key issues in tribal development are malnutrition and health problems, declining employment opportunities, land alienation, food insecurity and reduced food basket. These problems are due to loss of traditional shifting cultivation and loss of traditional food items such as ragi, chama, cholam, tubers roots etc. Food security is one of the best ways to attain livelihood security.

## Introduction

Tribal economy is a traditional one, characterized by high dependence on agriculture, minimum surplus allocation, and general reciprocity within the group. The livelihood options of the tribes are predominantly primitive in nature with minimal dependence on other means of employment. Livelihood security is adequate and sustainable access to income and other resources to enable households to meet basic needs, Household basic needs cover a spectrum of food, education, health, and personal needs,. Hence there is close relationship between food and livelihood security. They have many problems in terms of their livelihood security ranging from health related problems in general to problems pertained to poverty. Tribes cultivate land based on their food habits which help them for maintaining health and nutritional security. Roots and tuber crops occupy a remarkable position in their food habits. Tuber crops are key source of food, nutrition, and income in most of the marginalized populations. So these crops are suitable for cultivation in tribal area. Besides they produce more food per unit area of land, compared to many other crops and even women can cultivate these crops. Most of the tribes have limited knowledge about agricultural methods and food production. They are ignorant about the agricultural practice of producing maximum output with limited resources. Hence the purpose of the study is to suggest a cropping system including both food and cash crops by optimally using the resources such as land, labor and capital.

### Statement of the Problem

These are group of persons who are living together normally in hilly or high range area and who have not adequate communication or connection with normal people. The livelihood options of the tribes are predominantly primitive in nature (Throat, 2009) with minimal dependence on other means of employment. Major source of income is derived from casual wage labour, and forest woks. Generally the tribes are collecting forest products such as honey and either they sell these products by themselves or through cooperative societies and with that money they buy needy items. From this living style it is clear that they are not interested in cultivation or other activities to earn income and they meet their requirements even food through this system. With this minimum income they can not maintain food and economic security for better livelihood. The government and different organization had tried their best for uplifting the tribes by implementing various developmental programmes but the

goal was not up to the mark. Till now they are suffering from malnutrition, hunger death, poverty etc.

For uplifting the tribes a regular income through employment is necessary. So a change in their present living system is necessary. Since they are uneducated having no skill in any area they can take agriculture as occupation. But the resources used for the cultivation are limited. Maximum profit by using the available resource is a big problem. A combination of crops that give maximum profit by using the limited resources at the market price is the solution. As they have lack of knowledge in cultivation practices, market price of crops, resource availability etc proper guidance is needed. Hence a model is set up to suggest an optimum crop pattern which provides high profit within the available resource constraints and market prices which in turn gives livelihood security and financial stability to the tribes.

## Materials and Methods

Agriculture is the most primitive occupation of the tribal people. Though they had changed their cultivation pattern from travellers cultivation to settled cultivation. Some of the practices have remained unchanged among many groups of farmers. The paper focuses attention to the practices of the resource poor tribal farmers that make use of low cost renewable inputs, family and community labor for solving the food crises through their traditional wisdom which need documentation to make the future agriculture a sustained one.

Data were collected from 50 samples of high land area by following multistage sampling method. A linear programming (LP) study was undertaken in Malappuram district of Kerala to work out an optimum combination of crops in the tribal areas so that food and nutritional security as well as livelihood security can be maintained for them. LiPS V1.11.1is used to solve the problem.

Now a days the tribal groups in Malappuram district cultivate plantain, ginger, tapioca, coconut, paddy etc. in their available lands. Hence banana, tapioca, coconut and paddy are selected for the study. The core of linear programming problem was the fact that the resources were limited. In the study, the most restricting resources identified primarily were area of land, human labour and capital. Land, mostly forests, is the important natural resource and is under different uses, ranging from shifting cultivation to sedentary agriculture. Moreover Land is a finite resource. Hence there is a need for optimal utilization of land resources. Since hiring of labor is not possible tribes themselves can engage in agriculture. Labor supply is a big constraint in the production process. (One Man-day is calculated by taking 8 hours a day).Cultivation of paddy and banana needs huge investment. The capital requirements of farmers were met through the credits facilitated by government in the form of subsidy to inputs or loans free of interest. Capital is also taken as a constraint.

Within these constraints maximum attainable returns through the optimum allocation of crops were worked out using LP method. The final optimum plans are given by solving the linear programming problem through the simplex method.

Three situations are specified as follows.

$T_1$:  Type 1 optimum plan with no restriction on the use of land resources.

$T_2$:  Type 2 optimum plan with condition that the existing area of cassava and paddy should be retained.

$T_3$:  Type 3 optimum plan of intercropping of tuber crops with cash crops by retaining the existing area of cassava and paddy

In optimal plan 1, no restriction on the use of land resources is specified, which means farmers can cultivate crops at their will, having no limitation of the area under crops cultivated. For attaining food security cultivation of paddy and cassava is essential.

Plan 2 is formulated by taking paddy and cassava production as lower bound. Out of the crops taken for the study coconut and banana are considered as cash crops. Cultivation of cash crops is necessary since they generate income to the farmers. For attaining food security, food crops are also cultivated. Since the majority of farmers are small, and marginal intercropping of food crops with cash crops will provide adequate income to the tribes for better living along with food security. It ensures better land utilization and more returns.

Intercropping systems ensured maximum resource capture and use leading to higher yields per unit of soil, water and light. Tropical tuber crops such as tapioca, sweet potato, yams, elephant foot yam and cocoyams contributed 4.2 per cent of the human dietary intake and met the food and energy requirement of farm families. For this reason plan 3 is formulated. Since the rice is

Table 1. Income and level of resources used in optimum plans

| Optimum Crop Plan | Banana (in acre) | Paddy (in acre) | Cassava (in acre) | Banana and Y am (in acre) | Coconut and banana (in acre) | Coconut and yam (in acre) | Total income (Crores) | Land utilisation (in acre) | Labor ('ooo mandays) | Capital (in lakh) |
|---|---|---|---|---|---|---|---|---|---|---|
| Type 1 | 43.60 (133.4) | | 63.15 (127.6) | | | | 2.61 | 106.75 | 12.75 | 6.4 |
| Type 2 | 41.86 (128.1) | 34.49 (9.9) | 50.12 (101.2) | | | | 2.39 | 126.47 | 13.2 | 7.5 |
| Type 3 | | 34.49 (9.9) | 35.70 (72.1) | 35.21 (224.8) | 7.56 (34.3) | 22.74 (77.1) | 4.18 | 135.70 | 14 | 7.5 |

Figures in brackets are the income derived from corresponding crops in lakh.

their staple food and tapioca is major cultivated and cultivable crop in their area, maintenance of present paddy cultivation along with increased cultivation of tapioca through intercropping system can maintain the livelyhood security of the tribes.

As tribal farmers lack knowledge in agricultural practices only two crops are considered for intercropping. Greater yam and cassava are important food items of tribes, intercropping of these crops in banana and coconut is studied. Inter cropping coconut gardens with vegetables, pulses, tuber crops, fruit crops such as banana and pineapple makes for sustainable farming, according to Dr. V. Rajagopal, Director, Central Plantation Crops Research Institute (CPCRI), Kasargod, Kerala.

Five crop combinations are taken for the study. They are banana and tapioca, banana and yam, coconut and banana, coconut and cassava and coconut and yam. Since greater yam and cassava are important food items of tribes, intercropping of these crops in banana and coconut is studied.

## Results and Discussion

In optimum crop plan 1, among four crops (paddy, cassava, coconut, and banana) under study, only banana and cassava are economically feasible in hilly area. Banana is suggested to cultivate in 43.60 acre and cassava in 63.15acre. The income obtained from the first plan is 2.61 crores. Whereas resources are not fully used. Out of 135.7 acres of land available for cultivation only 106.75acre is used, about 1.25 thousand man days of labor and 1.1 lakh of capital remain unused. This may be due to the fact that they are not interested in cultivation. Hence further

cultivation is possible by using the unused labor and capital in the excess land area.

In plan 2 Banana is recommended to cultivate in 41.86 acre, paddy in 34.49 acre and cassava in 50.12 acre. The income derived in the second plan is 2.39 crores which is less than the first plan. At the same time resources are highly used than the first plan. This is mainly due to the compulsory inclusion of paddy (which is highly labour absorbing and having low market price) in the production process. Still land (9.23 acre) and labour (800 man days) remain unutilized. Cultivation can be extended by using these resources.

Inter cropping of tuber crops with banana and coconut is included in the third plan. Five crop combinations are taken for the study. They are banana and tapioca, banana and yam, coconut and banana, coconut and cassava and coconut and yam. Plan 3 proposed to cultivate paddy in 34.49 acres, cassava in 35.7 acres , crop combinations banana and yam in 35.21 acre, coconut and banana in 7.56 acre and coconut and yam in 22.74 acre. The income generated from the third plan is 4.18 crores which is almost double than the other two plans. All the resources are fully used in this plan. As the resources are fully used further production is not possible. Among crop combinations selected for the study banana and yam is more profitable.

## Conclusion

LP is used to find the crop combination which give maximum profit when there is a change in the market price of crops or availability of resources. Moreover it is a one click solution for crop planning in agriculture. It can be concluded from the study

that intercropping of crops can generate more income and maximum resource utilization. Cultivation of tuber crops with cash crop is preferable for attaining better income and food security. Optimum crop plan model 1 shows the present situation of the farmers. Plan 2 describes the cultivation practice for achieving food security. Plan 3 aims maximum returns from cultivation (both monetary and dietary). It generate more income and utilize all resources fully. The optimization model can be extended to the whole tribal area by including more crops which are agro economically suitable for their living or by including other constraints such as climate, soil fertility, plant nutrients and fertiliser application.

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