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Leapfrogging the Interventions of ICT Tools in Vegetable Intensification Pathways of Tamil Nadu: Farm Level Perceptions[§]

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Abstract

Vegetable crops have strong potential for income generation and making farming a viable proposition. But, the major constraints encountered by vegetable growers including perishability, market price fluctuation, and escalating cost of cultivation mar the prospects. This study has addressed farm profitability and value chain management aspects of tomato growers in the Salem, Dindigul and Krishnagiri districts of Tamil Nadu. A sample size of 300 respondents was used for the study. The study has revealed a skewed price spread at the farmers' end. At the same time, Shepherd's index has also been found very low (1.22), indicating market efficiency to be dismal. Though the majority of tomato growers perceived the need of vegetable clusters, 47 per cent of them were unaware of market intelligence services spearheaded by the use of information and communication technology (ICT) tools. The study has suggested leveraging the use of ICT tools to develop vegetable clusters in the vegetable intensification pathways. This will bring in not only horizontal integration of vegetable growers but also vertical integration of all members of the supply chain.

Key words: Price spread, market efficiency, marketing efficiency, vegetable clusters, ICT tools, vegetable intensification, Tamil Nadu

JEL Classification: Q 13, Q 16, O 13

Introduction

India is the second largest producer of vegetables with horticulture sector alone contributing 28 per cent of the agricultural gross domestic product of the nation coupled with 56 per cent of the total agricultural export

earnings (NHB, 2012). Growing demand for vegetables induced by rising incomes and changing consumption patterns along with declining farm incomes has necessitated diversification towards high-value crops such as vegetables, fruits, etc. in recent times. Apart from farm-income enhancement, vegetables have the potential to generate additional employment opportunities in farming due to their labour-intensive character (Weinberger and Lumpkin, 2006).

From the ecological point of view, diversification towards vegetables is beneficial to a farmer in crop rotation aspect as well. Since monoculture has resulted in the emergence of various problems like over-

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exploitation of groundwater resources, depletion of soil fertility and higher susceptibility of crops to the attack of various insect-pests and diseases (Sidhu, 2002), vegetable cultivation is being spearheaded as a good alternative. Thus, to improve farm income, provide gainful employment and save natural resources from further degradation, diversification from grain crops to high-value crops like vegetables has emerged as an important strategy for agricultural growth (Sekhon and Kaur, 2004). The vegetable intensification pathways (prolonged vegetable cultivation) are to be sustained in this regard. Farmers in these pathways have become specialized in the production of a specific vegetable. Trained labour force and regular supply of agricultural inputs are also readily available.

Despite these pathways having clear economic advantage in producing vegetables compared to other field crops, lack of marketing facilities is the major impediment (Navadkar, 2005). Issues of high cost of packing, high commission charges, high transportation costs, delayed payments to farmers and existence of malpractices in the marketing of vegetables are often mentioned as problems of the farming community (Kumar and Arora, 1999; Kumar *et al.*, 2004; Elenchezian and Kombairaju, 2004; Navadkar *et al.*, 2005). There are reservations on the potential of agro-processing to boost vegetable production due to lack of sufficient demand for processed vegetable products and very high capital requirements for such initiatives (Sidhu, 2002). On the marketing side, there has been a significant negative relationship between the market arrivals and vegetable prices (Khunt *et al.*, 2006). Due to inefficient marketing systems for vegetables, consumer's prices do not reflect the producer's share. Most of the vegetable growers sell their produce through commission agents and direct sales to retailers or consumers are negligible (Subramanyam, 1988). As a result, market intermediaries tend to apportion greater margins on the pretext of sharing larger proportion of producer's risk (Radha and Prasad, 2001).

This paper has carried out an in-depth supply-chain analysis of tomato crop in the vegetable intensification pathways of Tamil Nadu. Tomato was selected for analysis due to its importance in the production as well as consumption patterns. The crop is highly perishable and has high price volatility. Like other cultivators, local tomato farmers fail to create valuable regional production and marketing systems to remain competitive in the market. The present study has

estimated the costs and returns of tomato cultivation, identified different supply-chain systems and associated margins and finally has looked into the perceptions of farmers about the need of vegetable clusters leveraged with information and communication technology (ICT) tools. The specific objectives of the study were: (i) estimating farm profitability, price spread and market efficiency for tomato crop; (ii) understanding the constraints faced by tomato growers in the existing market chain, and (iii) assessing the role of ICT tools in the realization of vegetable clusters to improve supply chain management and farm income.

Data and Methodology

For the study, primary data were collected from the farmers and different market functionaries. The survey was conducted by a well-structured pre-tested questionnaire in the districts of Salem, Dindigul and Krishnagiri, known for largest acreage under tomato cropping in Tamil Nadu. The sample size was 300 and multi-stage random sampling technique was followed for the study. Major tomato-growing blocks or taluks were first identified using secondary sources and discussions with the agricultural department officials and two blocks were selected for each district. List of villages was obtained from the block level agricultural and horticultural officials and 10 villages were randomly chosen for each district. Then, the list of tomato growers of all the 10 villages in a district was obtained from the village administrative officers, village *panchayat* presidents and local agricultural input dealers. This was followed by random selection of 10 farmers each from each village. The marketing particulars were collected from a random selection of 60 traders and 60 retailers in the district level wholesale markets. Focus group discussions among farmers were also carried out to better understand the marketing situation and farm level profitability. The study period was from September and December, 2013. Costs and returns of vegetable disposal systems and marketing margins were estimated by using simple tabular analysis. STATA 11.2 software package was employed for further analysis.

Analytical Tools

Price Spread Analysis — Price spread was calculated as the difference between the price paid by the ultimate

consumer and that received by the growers per unit of the commodity (Acharya and Agarwal, 2004).

Marketing Efficiency — In this study, Shepherd's Index (Shepherd, 1972) has been used to analyze market efficiency (ME) as the ratio of total value of goods marketed to the marketing cost (MC) as follows:

$$ME = CP / MC + MM$$

where, CP is the consumer's purchase price and MM is the marketing margins.

Market Cost Analysis — After studying different models to analyze the determinants of marketing cost, a double log regression model of the following type was fitted:

$$\ln MC = \ln a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + e_t$$

where,

MC = Marketing cost incurred by farmers (₹/q)

X_1 = Quantity of vegetable marketed (quintals)

X_2 = Distance transported (km)

X_3 = Number of labour-days engaged in post-harvest operations

a = Constant term

e_t = Disturbance term, and

b_1 , b_2 and b_3 are regression coefficients.

Marginal Value — To test the efficiency, the ratio of marginal value (MV) to the marginal factor cost (MFC) for each input was computed and tested for its equality to 1, i.e. $MFC / MVP = 1$. The most reliable, perhaps the most useful estimate of MV is obtained by taking factors (X_i) as well as gross marketing cost (Y) at their geometric means. In this study, marginal value has also been computed for the variables influencing marketing cost of tomato farmers.

Garrett's Ranking Technique — To find the significant constraints of the farmers in accessing markets, Garrett's ranking technique was used (Garrett, 1981). The respondents were asked to assign rank to all the factors and the outcome of such ranking was converted into score value with the help of the following formula:

$$\text{Per cent position of the constraints faced} = \frac{100 (R_{ij} - 0.5) N_j}{N_j}$$

where,

R_{ij} = Rank given for the i^{th} factor by the j^{th} respondent, and

N_j = Number of factors ranked by the j^{th} respondent

By referring to the Garrett's table, the estimated per cent position of the constraints was converted into scores. Then for each factor the scores of each individual were added and the mean values obtained were considered to be most important and then were ranked accordingly.

Results and Discussions

Land Resources and Cropping Pattern

The average size of operational holding for tomato growers was 0.33 ha in the study area. Some of the vegetable farmers grew by leasing-in some land to increase their operational area. The crop is cultivated usually twice in a season comprising the months of June and October with perennial irrigation sources. But, in the district of Salem the majority of sample farmers cultivate in one season only.

Economics of Tomato Cultivation

The total cost of tomato cultivation, on an average, was estimated to be ₹ 48,951/ ha (Table 1). Across the variable costs of cultivation, the share of human labour exceeded 50 per cent, indicating the labour-intensive character of the tomato crop. The seed and nursery-raising were other important cost components accounting for 25 per cent and 16 per cent of the variable costs, respectively. Expenditure on fertilizers and pesticides was also a significant cost item. The share of fixed cost in total cost was at 18 per cent and the rental value of land constituted almost three-fourths of the total fixed cost. The gross returns from tomato crop were ₹ 123,045 / ha and net returns were ₹ 74,094/ ha.

Table 1. Farm profitability of tomato crop

Sl.No.	Particulars	Tomato
1	Yield (q / ha)	216
2	Price (₹/ q)	571
3	Gross returns (₹/ ha)	123,045
4	Total variable costs (₹/ ha)	42,038
5	Total costs (₹/ ha)	48,951
6	Returns over variable costs (₹/ ha)	81,006
7	Net returns (₹/ ha)	74,094

Source: Authors' survey

Marketing Channels for Tomato

In these vegetable intensification pathways, tomato was marketed through the traditional modes, namely village traders, commission agent / wholesaler, retailer and sometimes directly to the ultimate consumer. The three supply channels being followed for marketing tomato were:

Channel-I : Producer → Village trader → Commission agent / Wholesaler → Retailer → Consumer

Channel-II : Producer → Commission agent / Wholesaler → Retailer → Consumer

Channel-III : Producer → Consumer

It was found that more than 90 per cent of the produce was marketed through wholesalers and a small proportion was sold directly to consumers. Though the vegetable growers tend to diversify their market portfolio by selling directly to consumers to realize better prices for their produce, relatively small capacity of the channel to handle large volumes of the produce is a limitation. Hence, there is increased dependence on the commission agents / wholesalers for selling their produce and relatively greater vulnerability to sharp fall in prices in times of excessive production. Direct selling to consumers (Channel-III) though smallest in handling production, was found to be the most efficient, as it ensured not only maximum price of produce to the farmers but also largest share in the consumer's rupee (Table 2). The prices of vegetables and producer's share in consumer's rupee varied inversely with the length of the channel. The inclusion of more number of market intermediaries in the supply chain appropriated significant margins of the producers. This seems to be happening for facilitating easy and quick marketing of large volumes of the produce. However, intermediaries, especially wholesalers did not help the farmers in realizing better prices.

Marketing Costs and Margins in Supply Chains

The marketing costs, margins, price spread and Shepherd's Index for tomato have been presented in Tables 2. Under the producer – village trader – wholesaler – retailer – consumer supply channel (Channel-I), the marketing costs incurred by village trader, wholesaler and retailer were: ₹ 37 / q, ₹ 13 / q and ₹ 22 / q, respectively. The sample farmers didn't

have significant marketing costs while selling directly to village traders. In producer – wholesaler – retailer – consumer supply chain (Channel – II), the marketing cost incurred by producer was ₹ 37.36 / q, while the marketing costs of wholesaler and retailers remained the same. The producer's share in consumer's rupee was found 38 per cent in Channel-I and 55 per cent in Channel-II with the exclusion of village traders. As the links in a supply chain reduced, the share of producer in consumer price increased, indicating higher market efficiency under integrated supply chain systems.

Price Spread and Marketing Efficiency

Marketing channel in the vegetable intensification pathways started with village trader and flowed through commission agent-cum-wholesaler, retailer and ended with the consumer. The cost incurred by farmers by way of commissions was not included in working out the price spread to avoid double accounting since these were covered under profit margin of commission agents. The farmers selling in wholesale market directly incurred cost on grading, packing, transport, and agent commission. Commission charges constituted a larger share varying from 5 per cent to 15 per cent of the consumer's price.

Normally, the commission agents do not take the title to the produce and they merely negotiate the purchase and or sale (Navadkar *et al.*, 1991). But, in tomato supply chain the wholesalers were seen performing the role of commission agents as well. They bought and sold on their own gain or loss. The price spread was ₹ 686 / q (62%) in Channel-I and ₹ 456 / q (46%) in Channel-II (Table 2). The high value of price spread for tomato was due to high perishability and fluctuations in its price. Since the marketing cost and marketing margin in relation to consumer's price were higher, the Shepherd's Index of marketing efficiency was very low for tomato in Channel-I (1.22) as well as in Channel-II (1.73).

Marketing Cost Analysis

To identify the factors influencing marketing cost of farmers, the double log type of marketing cost function was fitted and the results of regression analysis are presented in Table 3. It was found that 72 per cent of variations in marketing cost of tomato could be

Table 2. Marketing costs, margins and price spread for tomato

(₹ / q)

Particulars	Channel-I	Channel-II	Channel-III
Farmer			
Net price received by producer	426	607	679
Village trader			
Price paid by village trader	426	-	-
Marketing cost	37	-	-
Profit margin	228	-	-
Marketing margin	265	-	-
Wholesaler-cum-commission agent			
Price paid by wholesaler	691	607	-
Marketing cost	13	13	-
Profit margin	265	301	-
Marketing margin	278	314	-
Retailer			
Price paid by retailer	819	819	-
Marketing cost	22	22	-
Profit margin	271	271	-
Marketing margin	294	294	-
Consumer			
Price paid by consumer	1113	1113	679
Producer's share (%)	38	55	-
Price spread	686	456	-
Shepherd's Index	1.22	1.73	-

Source: Authors' survey

Table 3. Marketing efficiency of tomato farmers

Particulars	Tomato	
	Co-efficient	Marginal value
Quantity marketed (in quintals), X_1	-0.016 ^{NS} (0.051)	-0.039
Distance to market (in km), X_2	0.089* (0.067)	1.43
Labour involved in post-harvest operation (in number of human-days), X_3	0.178** (0.04)	0.16
Intercept	1.61	
R^2	0.72	

Note: *and ** denote significance at 1 per cent and 5 per cent levels, respectively
 NS - Not Significant. Standard errors are within parentheses.

explained by the selected independent variables, viz. quantity of tomato marketed, X_1 ; distance to the market, X_2 ; and labour involved in post-harvest operation, X_3 . The regression co-efficient for quantity marketed was

negative, referring that any increase in quantity marketed would adversely affect the marketing cost, thus favouring the farmer but it was found not significant.

Table 4. Constraints perceived by sample tomato growers in the study area

Constraint	Farm respondents (n = 300)	
	Garrett's Score	Rank
Price volatility	64.77	I
Lack of technical support	58.40	II
Escalating cost of cultivation	53.00	III
Non availability of labour	51.55	IV
Lack of awareness about ICT tools	46.76	V

Source: Authors' survey

The distance to the market and labour involved were found affecting the marketing cost positively. The marginal value implied that for every kilometre increase in distance to the market from mean level, the marketing cost would increase by ₹ 1.43 and for one day increase in labour, the marketing cost would increase by ₹ 0.16 per quintal of tomato. This could only mean that increasing productivity (presently at 21.6 t / ha) will not serve unless the spatial distribution of production is taken care of. Focus group discussions revealed that the farmers perceived a loss of 20-25 per cent of the tomato harvest due to lack of post-harvest and proper storage facilities.

Farmers' Perception of Constraints

Garrett's ranking analysis revealed that price volatility was the major impediment (64.8%) perceived by the farmers (Table 4), followed by lack of technical support (58.4%), escalating cost of cultivation (53.0%) and shortage of labour force (51.5%). The farmers had no idea of market requirement and market contracts were not heard of. It was also found out that about 47.0 per cent of tomato growers were unaware of market intelligence and price forecasting given through ICT tools, including mobile based SMS.

Farmers' Perception of Leveraging ICTs for Realizing Vegetable Clusters

The vegetable clusters are geographically bounded concentrations of interdependent and complementary farmers, connected to each other by using same technology, technical know-how, and agro-inputs. The prospects of better remuneration from vegetable

cultivation get often blurred due to perishability of produce, highly volatile market prices and escalating cost of cultivation. Thereby, such vegetable clusters can pave way for knowledge transfer, development and diffusion of innovations and trustful cooperation and can lead to spatial organization of production (Martin and Sunley, 2001). These clusters could also help in shared costs for infrastructure, buildup of a skilled labour force, transaction efficiency, and knowledge spill-overs leading to firm learning and innovation (Pyke and Sengenberger, 1992).

Figure 1 showcases the opportunities of vegetable clusters to the farm community. Empowering vegetable clusters with ICT tools is the primary requirement for their functioning. As farmers would be better equipped with market intelligence, spatial distribution of cropping would become possible, resulting in lesser chances of glut and improvement in market efficiency. At the same time, as ICT-enabled clusters would offer better chances to farmers to plan their cropping and take better decisions, transportation costs would be curtailed, thus, improving marketing efficiency. This would result in effective weeding out of asymmetry which is a common feature in the marketing of agricultural produce.

With formation of vegetable clusters, post-harvest losses would be avoided due to increased possibility of agro-processing opportunities. As the value chain management moves up in the agro-processing sector, the durability option of sale of produce also gets widened, giving a fillip to market efficiency. The possibility of marketing contracts not only improves price spread to the advantage of farmers but also increases the chances of rise in farmer's share. To sum up, the vegetable clusters flanked with ICT tools would pave way for sustainable profit as the risk of income failure gets reduced to an appreciable account.

The ICT includes any communication device or application (like radio, telephone, television, internet, mobile phone, etc.) that is put to the service of farmers in both production and marketing aspects. It could be seen from Figure 2, that tomato farmers in the study area prefer leveraging the application of ICTs over the present marketing channel. Farmers also appreciated the concept of vegetable clusters and perceived that vegetable clusters empowered by ICT tools would help them in both production and marketing aspects. As it could be seen from Figure 2, the farmers perceived

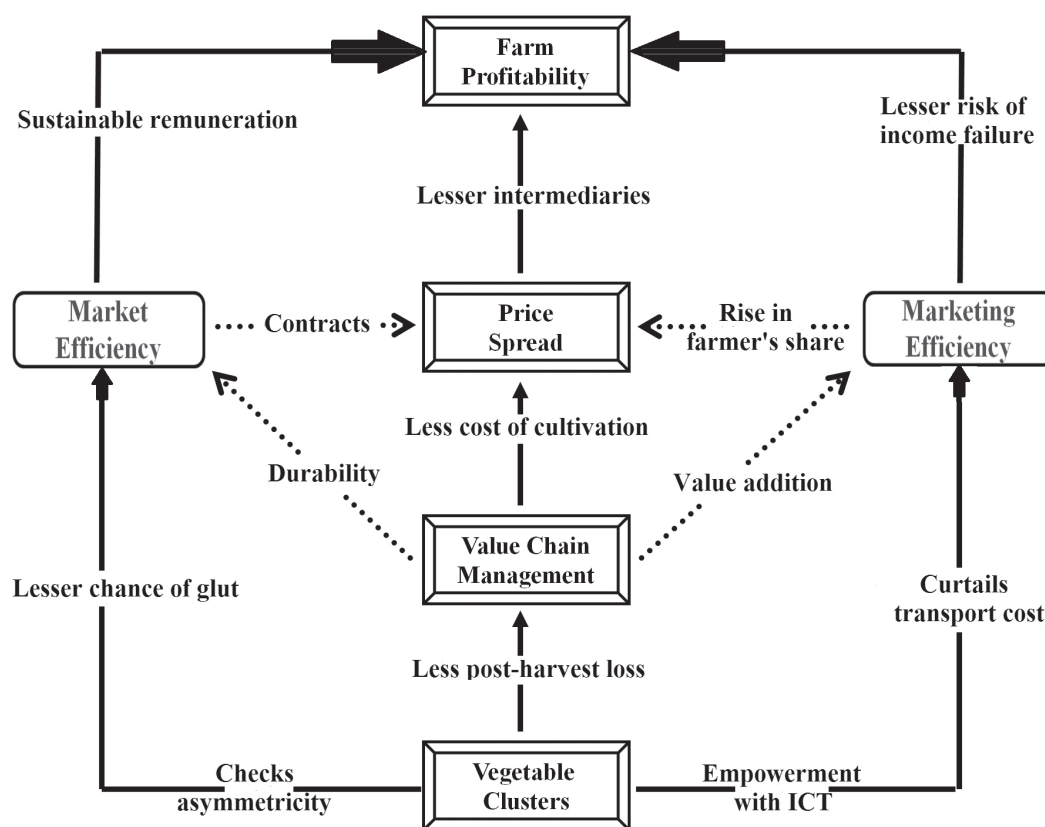


Figure 1. Importance of vegetable clusters in sustainaing farm profitability

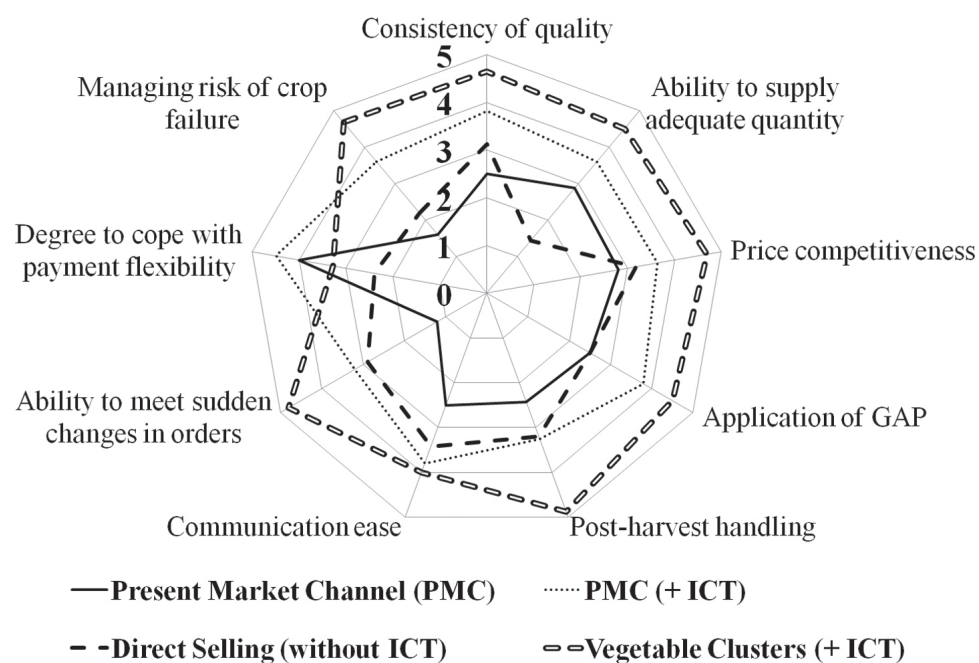


Figure 2. Farmers' perception of leveraging ICT tools in realizing vegetable clusters

Note: Likert Scale of 1 to 5. GAP = Good Agricultural Practices

that the option of vegetable clusters along with ICT would be the best (4.65) when it came to the consistency of quality, followed by the option of present market channel + ICT (3.82). However, with the present market channels option, farmers perceived that maintaining consistency in quality was largely difficult (2.5).

At all the fronts of post-harvest handling (4.87), ability to meet sudden changes in orders (4.8), price competitiveness (4.69), managing risk of crop failure (4.67), application of good agricultural practices (GAP) (4.5), and ability to supply adequate quantity (4.5), the farmers perceived that the introduction of vegetable clusters facilitated by ICT would be of great advantage. Even the introduction of ICT tools in the present market channel was perceived to be beneficial. The only area in which the farmers were comfortable with the present marketing channel was the degree of coping with the payment flexibility (4.0). It seems that the farmers were so familiar with the market intermediaries in the present market channel that even the vegetable clusters with all their intended benefits were considered to be risky. But, the ICT tools should be made widely prevalent and easily accessible before integrating all the production and marketing services with vegetable clusters.

Conclusions and Outlook

Vegetables have strong potential for income generation, but the problems of perishability, market price fluctuation and cost of cultivation blur the prospects. The supply chain management and market efficiency play a crucial role in this regard. It could be well ascertained that widespread use of information communication and technology (ICT) tools would improve market efficiency and work out price spread of the produce in favour of the producers, thereby enabling a fair trade for all the members of the supply chain. The study has suggested that widespread use of ICT tools in the development of agricultural clusters would bring out not only horizontal integration of vegetable growers but also vertical integration of all the members of the supply chain, leading to better prospects of farm profitability. Apart from checking asymmetry in the market, mutual trust and cooperation among farmers need to be encouraged first for making vegetable clusters a reality. Also, modernizing the marketing system by leveraging or

upscale the intervention of ICT tools is of utmost priority. Vegetable clusters spearheaded by ICT tools would possibly create spatial distribution of production, thereby ensuring sustainable remuneration and preventing possible glut in the market.

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