Resources Management for Income Optimization in Smallholder Food Crop Farms in South-Western Nigeria

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Summary

Agricultural mobilization based purely on resources availability factor alone may falter due to inadequate attention that is hitherto paid to other complementary factors. Empirical evidence from the current study conducted on typical small-holder farms in South-western Nigeria has shown that while the availability of the required input resources were essential in raising income on small-holder farms, resources management choice factor was the most relatively crucial. With better choice of management and careful selection of enterprises, the current level of available resources at the disposal of small-holder farmers in the study area was adequate to make them economically viable and improve their potential savings. Income realizable with 'better' management plan option was N 359,761.79 per hectare while ₦ 164,213.88 per hectare was earned with the current level of resources use and enterprise combination. The better management plan recommended the cultivation of cassava/yam (0.59 ha.), maize/cassava (0.34 ha.), Banana-plantain (0.26 ha) and maize/cocoyam (0.22 ha) on 1.42 hectares of land instead of the current 2.37 hectares (67% increase) cultivated mostly to sole cropping. However, the additional human and financial requirements of the proposed better management plan called for dedicated and active government action programmes in form of provision of most input needs of farmers at subsidized rates, provision of extension and training in modern farm management and organization techniques and establishment of advisory service centers to monitor and supervise the use of resource inputs on farms.

Résumé

Gestion des ressources pour l'optimisation du revenu des exploitations agricoles vivrières du du sud-ouest du Nigeria

La mobilisation de l'agriculture purement basée sur le seul facteur des ressources appropriées peut faillir à cause du focus incertain accordé à d'autres facteurs complémentaires. La donnée empirique de notre étude en cours menée sur les petits propriétaires des champs au Sud-ouest du Nigeria montre que lorsque nous nous focalisons sur des ressources de base pour le relèvement du revenu chez ces derniers, le choix du facteur gestion des ressources est relativement important. Avec un choix excellent de la gestion et une sélection acquittée des entreprises, le degré de la mise en disposition des ressources appropriées aux petits propriétaires des champs dans notre domaine d'étude est suffisant pour les rendre économiquement auto-suffisants et améliorer leur épargne potentielle. Le revenu qu'on pourrait réalisé avec une option de plan de « meilleure » gestion est de N 359.761,79 par hectare tandis que celui généré par le degré nouveau d'utilisation des ressources et la combinaison de l'entreprise est de ₦ 164.213,88 par hectare. Le meilleur plan de gestion recommande la culture du manioc/igname (0,59 ha), maïs/manioc (0,34 ha), banane/plantain (0,26 ha) et maïs/taro (0,22 ha) sur un terrain de 1,42 hectares contre l'actuel 2,37 hectares (67% de plus) sur lesquels sont cultivés uniquement les produits homogènes. Néanmoins, en dépit des demandes humaines et financières du meilleur plan de gestion s'ajoutent les programmes d'action actifs et sincères du gouvernement en forme de mise en place des fonds de démarrage aux paysans à des prix subventionnels, l'approvisionnement de formation avancée sur la gestion du travail champêtre moderne et l'organisation technique et établissement des centres de service consultatif en vue de contrôler et superviser l'application des ressources de base dans les champs.

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Note: ₦ means Naira (Nigerian currency);$1(one dollar) is equivalent to ₦ 150 as at the time of this study.

Introduction

The higher the realizable income from an investment, ceteris paribus, the greater could be the potentials for savings, which may in turn be needed for further investments. Investment as used in this context, refers to commitment of resources made in the hope of realizing benefits that are expected to occur over a period of time in the future. In Nigeria, agriculture is the most important industry (1, 14). The limited resources available to most investors in the sector, however, make them to be very careful in deciding what particular venture to undertake in order to maximize profit, minimize loss and/or avert risks (18). A policy objective in most developing economies is to achieve overall economic development through growth in agricultural production and productivity. An important variable used very often to achieve the policy goal is subsidized cost of capital either in the form of lowering the interest on agricultural loans or subsidizing the cost on inputs in order to enhance farm income. Increased farm income would enable greater re-investment in agricultural production and facilitate overall economic development of a nation. There are two schools of thought on the role of credit in agricultural development. One of them argues that non availability of credit on suitable terms is a major bottleneck on agricultural development because adoption of modern farm practices involves the purchase of improved inputs. Few small-scale farmers have the financial capabilities to make such purchases and the traditional sources of credit cannot supply the needed credit on acceptable terms. In line with this thought, some authors (4, 12, 13, 20) have asserted that the decision of farmers to expand production and re-invest their resources was based mainly on the adequacy of credit which served as the exclusive pillar on which development could be placed. The other school holds the view that lack of credit per se does not limit agricultural modernization but rather the absence of other "essentials" necessary for development. It argues that if these essentials are available, the needed credit will be forthcoming from financial resources already available at the village level. Thus, the view that credit is non-necessary critical factor and is just but one of the many important input resources vital for agricultural development is eminently supported (15, 21). According to them, evidence abounds to confirm that some farmers performed better than others, given the same level of credit opportunities. Although each view point has its merits and demerits depending on its assumptions, emphasis and stage of development, it should be noted that

extending credit to small-holder farmers who do not have genuinely profitable uses for credit is a disservice.

According to Miller, such farmers acquire debt obligations without any concomitant increase in income with which to repay the credit while the lending institutions may be burdened with collection problems (16). However, it was also noted that even where profitable technology existed and farmers were convinced of its value, its adoption by small farmers may be prevented by lack of credit to buy improved inputs needed (3). It is therefore necessary to identify the factor determinants of economic performance of farmers using varying levels of production resources. Thus, this paper examines the relative importance of management of credit and other resource factors in the optimization of income on small-holder farms in South-Western Nigeria. The specific objectives are:

(i) to estimate costs and returns of smallholder food crop farmers with existing levels of the resource management and farm practices;

(ii) to determine the conditions for attaining optimum level of income by the farmers at the current level of resource availability;

(iii) to identify the major income-enhancing resource management factors under optimum resource utilization by the farmers; and

(iv) to advise on policy implications based on the results of the analyses.

Materials and Methods

The data analyzed for this study were obtained from 200 respondents who co-operated fully out of the 225 samples randomly taken from the 2,265 small-holder food crop farmers participating in the organized and sponsored farm groups of Isoya Rural Development Projects (IRDP) of Obafemi Awolowo University, Ile-Ife. Data Collection was done through farm survey using questionnaire schedule administered in the 2009 and 2010 cropping seasons to revalidate the data with those obtained from similar surveys previously carried out between 1987 and 1999 in the study area. IRDP is an outreach project of the Faculty of Agriculture, Obafemi Awolowo University, Ile-Ife, covering 13 small villages privileged with a lot of extension input since the last 35 years. Information collected included those on production resources availability and use, income, credit availability and use, yields and prices.

Budgeting was used to estimate the levels of income under the existing system of resource use and enterprise management and the Linear Programming (LP) technique was applied to examine the optimality conditions for the resources used as well as the incomes due to farmers. In both cases, a representative farm was chosen to possess the characteristics of a typical average enterprise farm. Such farms would have:

(a) a land area of 2.37 hectares, equivalent to the average farm size per farmer,

(b) an average amount of ₦ 250,000 capital for operating the specified farm size,

(c) an average labor force of 320 man days available yearly for the farming household and;

(d) a minimum quantity of each food crop required per farming household (see table 1).

For the budgetary analysis model, average net returns were obtained by subtracting the average expenditure from the average returns per hectare for each enterprise while for the LP model, gross

margins (GM) of the various enterprises (sole and mixed) were specified as the objective functions to be maximized subject to the constraining resource limits of rain-fed land, family and hired labour, owned and borrowed capital and minimum household consumption of each of the crops cultivated by households as presented in table 1.

After using the basic data to obtain the real farm optimal solutions (LP-advised practice), some variations in the input-output coefficients were postulated and several re-runs were carried out in accordance with the parametric programming approach to obtain the sensitivity of gross margins to the postulated changes.

This was to investigate the effects of changes in capital and/or other resources on the potential farm incomes. Results of both models were compared to investigate the effects of resources management and, that of the parametric programming served a pointer to the influence of variations in input factors on the direction of realizable income on small-holder farms.

Results and Discussion

Socio-economic characteristics of households in the study area

Figure 1 gives a summary of households' sources of funds for food crops farming and the use to which such funds are put in the study area. The main sources of funds for small-holder food crop farmers in the study area were personal savings (66%), and borrowed funds from Co-operative farm groups (20%), Friends and relatives (7.5%), Local

Table 1
Minimum Consumption Requirements of Crops by Households.

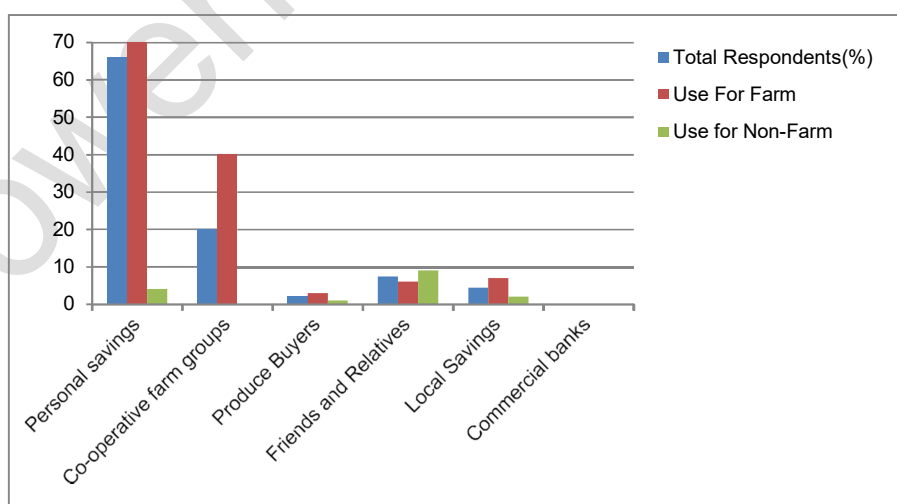| Crop	Number of Farmers	Total Output Produced (tons)	Proportion Consumed	Amount Consumed (tons)
Maize	186	266,3	0,378	0,347
Cassava	183	1.140,09	0,2	1,246
Yam	104	362,45	0,466	1,638
Cocoyam	88	167,37	0,518	0,989
Banana-Plantain	16	34,03	0,596	1,31

Figure 1: Distribution of Respondents by Ownership of Funds used on Farms.

savings group (4.5%) and Produce buyers (2%). Farmers did not get credit from Commercial Banks which are the formal lending institutions. One hundred and eighty four (92%) of the sampled farmers used such funds for farming purposes while the remaining 16 farmers (8%) used them for purposes which included health care (4%), school fees for children (2.5%) and feeding expenses (1.5%).

Budgeting and Basic Linear Programming Results

Tables 2 and 3 present the results obtained from analyses on Budgetary and Linear Programming techniques respectively.

As shown in table 2, the maximum farm income realized with the current resource management

practice was ₦ 389,186.89 which required the use of 2.37 hectares of land, 197.41 man-days of labor and ₦ 240,280.58 out of pocket operating expenses.

In order of importance, the most income enhancing enterprise combinations on per hectare basis were maize/cassava/yam, banana-plantain and cassava/yam whose calculated gross margins were ₦ 446,505; ₦ 420,250 and ₦ 366,305 respectively, while the mostly preferred practice by farmers were sole maize and sole cassava enterprises where 33.33 percent (0.79 hectare) and 19.83 percent (0.47 hectare) of total land allocation were devoted respectively. The size of land used for the identified income-enhancing enterprises were 0.06 hectare (2.53%), 0.05 hectare (2.11%) and 0.05 hectare (2.11%) respectively.

Table 2
Budgeting Plan (Existing Practice) for the Small-holder Food Crop Farmers.

Available Enterprise	Analysis		per Hectare			Existing	Practice	
	Labor Requirement (mandays)	Operating Expenses	Gross Margin	Farm Size cultivated (ha)	Labor Requirement (mandays)	Operating Expenses	Gross Margin	Farm Income
		(₦)	(₦)			(₦)	(₦)	(₦)
Maize (Mz)	53	53.832,50	130.720,00	0,79	41,87	42.527,68	103.268,80	100.027,30
Cassava (Css)	71	67.782,50	117.022,50	0,47	33,37	31.857,78	55.000,58	51.759,08
Yam (Ym)	128	310.957,50	249.700,00	0,19	24,32	59.081,93	47.443,00	44.201,50
Cocoyam (Ccym)	115	102.270,00	125.532,50	0,11	12,65	11.249,70	13.808,58	10.567,08
Banana/Plantain	203	250.707,50	420.250,00	0,05	10,15	12.535,38	21.012,50	17.771,00
Mz/Css	80	170.576,65	430.273,30	0,03	2,4	5.117,30	12.908,20	9.666,70
Mz/Ym	127	249.515,00	497.801,20	0,04	5,08	9.980,60	19.912,05	16.670,55
Mz/Ccym	74	81.082,50	213.505,00	0,33	24,42	26.757,23	70.456,65	67.215,15
Css/Ym	137	172.832,60	366.305,00	0,05	6,85	8.641,63	18.315,25	15.073,75
Css/Ccym	96	94.770,00	189.927,50	0,17	16,32	16.110,90	32.287,68	29.046,18
Ym/Ccym	134	217.427,50	343.765,00	0,02	4,68	4.348,55	6.875,30	3.633,80
Mz/Css/Ym	154	201.115,00	446.505,00	0,06	10,24	12.066,90	26.790,30	23.548,80
Mz/Css/Ccym	99	129.645,00	248.707,50	0,04	4,96	5.185,80	9.948,30	6.706,80
Total/Farm	-	-	-	2,37	197,41	240.280,58	421.027,19	389.186,89
Analysis/hectare	-	-	-	-			177.648,60	164.213,88

Table 3
Optimum/Basic Plan (L P –Advised Practice) for the Small-holder Food Crop Farmers.

| Enterprise Combination Recommended	Size of Farm Advised (ha)	Labour Requirements (mandays)	Operating Expenses (₦)	Gross Margin (₦)	Farm Income (₦)
Banana – Plantain	0,26	54,34	63.788,25	109.265,10	106.871,74
Maize/Cassava	0,23	17	17.456,40	46.971,10	44.954,48
Cassava/Yam	0,59	80,82	99.787,85	216.119,94	210.695,06
Maize/Cassava	0,34	52,36	72.342,50	151.471,70	148.340,46
Total/Farm	1,42	204,52	253.375,00	523.827,75	510.861,74
Analysis/hectare	-	-	-	368.892,78	359.761,79
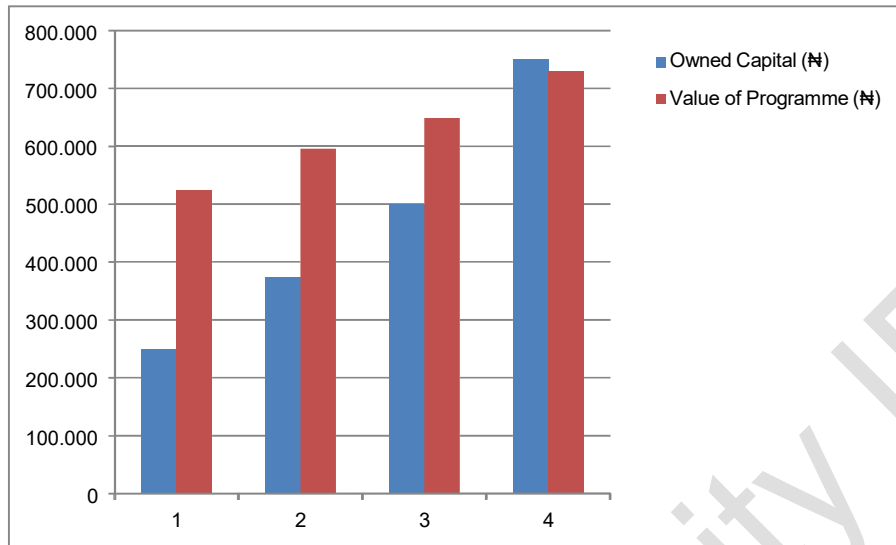
Figure 2: Alternative Plan I-Comparison of Optimum Farm income when owned capital is parametricised in the basic plan.
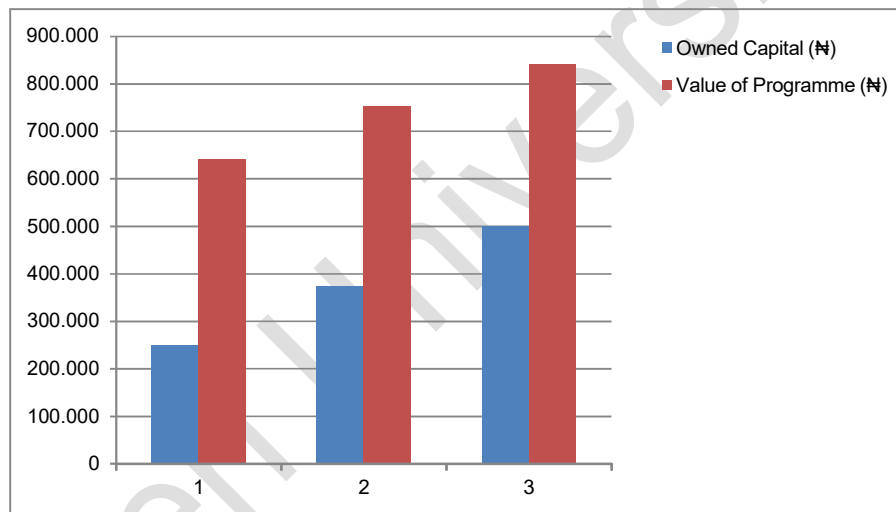

Figure 3: Alternative Plan III-Comparison of Optimum Farm income when Family Labor is parametricised in Alternative Plan I.

The observed preference for sole and less income-enhancing crop enterprises could be explained in terms of the peasant farmers' goal of satisfaction of subsistence (11). While maize is a crop that bridges the "hungry gap" being the first crop usually to be harvested yearly in the study area, cassava has become a staple food over the years due to the ever-increasing prices of other supplementary bulky starch foods like yam and rice.

The Linear Programming results (Table 3) showed that given the present level of available resources, the optimal conditions were 1.42 hectares of land, 204.52 man-days of labor and operating expenses ₦ 253,375. With an income of ₦ 510,861.74 there was an increase of N 121,674.85 (31.26%) above

the income realizable with the current management practices.

The optimal enterprise combinations included in order of importance cassava/ yam, maize/-cassava/yam, banana-plantain and maize/cocoyam where 0.59 hectare (42%), 0.34 hectare (24%), 0.26 hectare (18%) and 0.23 hectare (16%) of the 1.42 hectares of land were devoted respectively. On per hectare basis, the LP- advised plan gave a farm income of N 359,761.79 which is an increase of 119 percent over N 164,213.88 realized with the current resource management practice.

As observed, the average farm income obtained from the L.P. model was greater than that obtained

from budgetary analysis. The L.P. method evolved maximum income management practices while the budgetary analysis approach indicated maximum income realized with the existing resource management, which was not based entirely on income maximizing objective. These differences in income in the two models result from differences in resource use management, choice of enterprises and their combinations.

Results of Parametric Programming

All the three basic variables (land, family labor and owned capital) were parametricised. Land area was increased from 2.37 hectare to 3.56 hectares to reflect the true arable crop land situation of about 4 hectares per farmer in the study area. Annual family labor was increased from 320 to 480 man-days, representing a 50 percent increase, to eliminate some of the idle manpower resources and owned capital was increased by 50, 100, and 200 percent of the current level to investigate the effects of improvement in the levels of credit availability. These modifications were made to the original basic matrix to model out the alternative plans which would be used to investigate the effects of the three basic variables individually and/or collectively on farming income. The results are as presented in the alternative plans discussed below.

(i) Alternative Plan I

The results of the analysis carried out with the adjusted matrix where owned capital was varied between ₦ 250, 000 to ₦ 750, 000 is shown in figure 2.

An increase in capital resources resulted in increase in optimum gross margin (consequently farm income), the increase being N 72,400 for a 50 percent increase in capital, N 125,242.95 for 100 percent increase and N 205,695.80 for a 200 percent increase. The same combination of enterprises as in the basic plan entered the programme in all the plans though at different values. The observed increase in revenue was due to utilizing land resources that were idle when capital constrained production. However, as expected, the Marginal Value Productivities of capital decreased with increasing capital supply.

(ii) Alternative Plan II

The specific modifications in this plan include land, limited at 3.5 hectares a 50 percent increase above the initial level of 2.37 hectares and capital, varied between ₦ 250,000 and ₦ 750,000. This was with a view to ascertaining the effects of increasing land and or capital resources on improving the gross margins (value of programme) of the alternative plan I.

The results obtained showed the various values of programme for the plan to be identical with those of alternative plan I when land area was limited at 2.37 hectares. This confirms that land was not limiting to increasing income with the current level of other resources.

(iii) Alternative Plan III

In this, family labor was increased to 480 man-days per annum, that is, 50% increase above the existing level. Capital was also varied between ₦ 250,000 and ₦ 500,000. The result of the analysis is shown in figure 3.

As could be observed, the value of programme at the ₦ 250,000 capital level was ₦ 642,573.80. Optimum income has increased by ₦ 118,746.05 (22.66%) above the ₦ 523,827.75 of the basic plan. Also, increasing the capital levels with the current 480 man-days of labor input has improved the various values of programme of the alternative plan 1. The range of improvements was 26.29 percent and 29.77 percent for the ₦ 375,000 and ₦ 500,000 capital levels respectively.

Thus, with the current levels of labor resources especially, land could not be limiting to increasing farm income. An increase in labor and capital resources would however increase optimum farm income substantially. The four optimal enterprises in alternative plant still remained optimal for the current plan though at varying levels. The Marginal Value Productivities of labor and capital remained high even when their levels were increased by 50 and 100 percent respectively. These values however decreased with further increase in the levels of labor and capital.

Conclusion

While the availability of needed credit (capital) and the required farm labor are among the farm resources that could enhance income on food crop farms, management and combination of resource use factors are also crucial. Thus, for the design and implementation of programmes aimed at increasing income on small-holder farms, efficient combination and management of available resources (7, 19) is as critical as finance. Extension of credit to small-holder farmers to increase production and enhance income should be coupled with adequate training, monitoring and evaluation of performance of the credit recipients in the efficient management of credit and other complimentary resources. The direct relationship existing between

loan default and poor supervision has long been confirmed (16). Also incidences of under employment (10) and/or disguised unemployment (17) on small-holder farms need not be over-emphasized in developing countries like Nigeria. Optimum farm income could only be achieved if there is an improvement in the management of existing resources at the disposal of farmers. This includes choice of the right combination of enterprises, efficiency in the use of land and labour and appropriateness in the use of funds (9). Availability of labour and capital could not do the desired good if complementary factors of judicious management of resources are nonexistent. For example, results obtained from the survey area have shown that with an efficient management of the existing resource inputs, and a careful selection of crop combinations, the optimum farm income of ₦ 359,761.79 per hectare realizable represents an increase of ₦ 195,547.91 or 119 percent above the ₦ 164,213.88 earned with the current management practices. However, the results obtained from labour and capital parametrisation analysis showed that with a 50 percent increase in existing labour supply, the optimal farm income could be improved by ₦ 118,746.05 (22.67%) and when in addition capital is increased by 50 and 100 percent, the optimum farm income improve by ₦ 229,141.20 (43.74%) and ₦ 318,472.10 (60.80%) respectively above the basic plan results. Thus, farmers could only maximize their income and improve their current earnings if they adopt the optimum farm plans recommended by the Linear Programming technique in preference to the existing practices.

The farm management plan that favored optimum income suggested that the existing practice of sole cropping of all crops should be changed to diversified cropping involving cassava /yam (24%), maize/cocoyam (16%) and banana-plantain (18%). Andrew and Fox have supported diversification of crops as a good means of intensifying the use of arable lands (2). Such diversification however has to be done with caution so as not to produce negative results (6, 8).The said change also required that additional financial and human resources be used. These could be taken care of if farmers are encouraged, through price incentives to save and provide the bulk of their needed capital (5) and if drudgery in farming is removed by making available for farmers use, affordable labor assisting technologies like simple hand-operated machines, improved seeds and seedlings. Also farming programme should be planned to ensure even and timely distribution of labor all the year round. Finally, more agro-service centers should be established in the study area to service the immediate improved inputs and packages need of the small farmers. These could further enhance the optimum income level if supplemented with provision of adequate extension and training programmes for farmers in farm organization and management techniques. In order to achieve the desired result, modest improved cultural practices should be recommended for the farmers.

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