RESEARCH ARTICLE Agricultural Scinece Digest, Volume 39 Issue 4: 268-273 (October-December 2019)

Optimum Crop Planning for Better Resource use Efficiency, Sustainability and Maximizing Farm Net Income in Assam

Rinumoni Buragohin, P.P. Bora, J.P. Hazarika and Nivedita Deka

10.18805/ag.D-4726

ABSTRACT

In Assam, most of the crops are grown with productivity that is lower than the potential yield. Potential utilization of irrigation is not much encouraging in the state. Besides, most of the farmers are marginal and small farmers leading to low mechanization in Assam agriculture. Therefore, a proper crop planning is needed that would help the farmers to select crops for mechanization under assured irrigation that will give them higher profit. The study has been under taken with the objective to develop optimum crop planing for better resource use efficiency, sustainability and maximizing farm net income across production environments by using linear programming (LP) through GAMS (General Algebraic Modeling System). The resulted optimum crop model showed that, the areas under almost all the major crops grown in Assam have the scope to be increased under the land constraint of the state both in existing and improved irrigated situation and to contribute more in farm income. From the result of the study, it can be concluded that, besides rice, crops like maize, sugarcane, jute, mustard, pea and vegetables like tomato, brinjal, cauliflower, chilies etc can be seen as potential crops in a profitable crop plan for the state.

Key words: Crop planning, Linear programming, Resource use, Sustainability.

INTRODUCTION

Assam is one of the north eastern states of Indian union with a geographical area of 78438 sq. km. (of this 20 per cent are hilly area) which is about 2.4 per cent of the country's total geographical area and providing shelter to country's 2.6 per cent population (Economic Survey of Assam 2014-15). The economy of the state is predominantly agrarian in nature. The net cultivated area of the state is 28.11 lakh hectares (2014-15) which is about 88 per cent of the total land available for agricultural cultivation. Rice being the staple crop occupies 89 per cent of the net cropped area and 60 per cent of the gross cropped area (Statistical Handbook of Assam 2014-145. In Assam, the cropping pattern is not very efficient in terms of resources use. Cropping intensity of the state is only 139 per cent (2013-14). This leads to serious misallocation of resource, efficiency loss, indiscriminate use of land and water resources and it adversely affecting long term production prospects. In Assam, the productivity of most of the crop is lower than the potential yield. The irrigation potential utilized is not much encouraging in the state. The agriculture of the state is purely rain fed with only 4.33 per cent gross cropped area under irrigation (during 2011-12). Low irrigation coverage coupled with low uses of fertilizer and high yield varieties of the crops are some of the contributing factor for the low yield of the crops. Further, the available water from natural rainfall is distributed over only six months causing water scarcity during cultivation of *rabi* crops. Besides, most of the farmers belong to marginal and small farmers' category, leading to low mechanization in Assam agriculture. Many researchers showed that a proper crop planning would help the farmers to select crops for mechanization under assured irrigation that will give them higher profit. Again, a crop plan that would help to optimize the level of each activity of different crops, level of input use and output produced under different resource endowment and price scenario. Paidipati and Padi (2017) have developed two linear programming problems for optimal allocation of agricultural land with the objectives of minimizing farming costs and maximizing the revenue. Wankhade and Lunge (2012) developed a linear programming (LP) technique for optimum resource allocation and the efficiency in the agricultural production with the data on 10 major crops in the area of rain fed zone of Murtizapur Tahsil of Akola District in Maharashtra, India. Against this backdrop, this study has been under taken with the objective to develop optimum crop plan for better resource use efficiency, sustainability and maximizing farm net income across production environments.

Department of Agricultural Economics, Faculty of Agriculture, Assam Agricultural University, Jorhat-785 013, Assam, India.

Corresponding Author: Nivedita Deka, Department of Agricultural Economics, Faculty of Agriculture, Assam Agricultural University, Jorhat-785 013, Assam, India. e-mail: ndeka1@rediffmail.com

How to cite this article: R. Buragohin, P.P. Bora, J.P. Hazarika and N. Deka (2019). Optimum Crop Planning for Better Resource use Efficiency, Sustainability and Maximizing Farm Net Income in Assam. Agricultural Science Digest. 39(4): 268-273.

Source of support: Nil

Conflict of interest: None

Submitted: 09-02-2018 **Accepted:** 08-11-2019 **Published:** 06-12-2019

MATERIALS AND METHODS

The study was conducted for the whole state of Assam. The study is primarily based on plot level data collected under "Comprehensive Scheme for Cost of Cultivation (CCS) of Principal Crops of Directorate of Economics and Statistics, Ministry of Agriculture. In this study, the data pertaining to

year 2009-10 and 2010-11 were used. In the present study net returns or performance of different crops had been assessed by comparing net returns under alternative scenarios. Those were: (i) Market prices; (ii) Economic prices net of subsidies; and (iii) Income based on natural resource valuation technique (Raju *et al*. 2015). For the development of optimum crop model, cost and returns based on Market Prices (MP), Economic Prices (EP) and Natural Resource Valuation (NRV) were estimated as follows:

$$NR_{MP} = GR - VC$$

The net return at market prices was computed as the gross return (value of main product and by product) less variable costs (Cost A1 + imputed value of family labour) actually paid and received by the farmer or imputed in some cases (Jain *et al*. 2015).

$$NR_{EP} = NR_{MP} - \text{fertilizer subsidy}$$
$$NR_{NRV} = (NR_{EP} + \text{Value of N}) - \text{cost of GHG}$$

Where,

NR_{MP} = Net return at market prices;
GR= Gross Returns;
VC = Variable cost;
NR_{EP} = Net return at economic price;
$NR_{NRV=}$ Net return on Natural Resource Valuation;
Value of N= Value of nitrogen fixation by legume crops at economic price of nitrogen;
Cost of GHG = Imputed value of increase in GHG emission cost to the atmosphere

Optimization of crop model

The present study made an attempt to develop different crop planning strategies by using linear programming (LP) through GAMS (General Algebraic Modeling System).

Mathematically, model specification is presented by the following equations:-

Max Z = $\sum_{c=1}^{n}(Y_c P_c - C_c)A_c$ ...(1)

$$\sum_t \sum_c \alpha_{tc} A_c \le NS_t - OA_t \quad ...(2)$$

$$A_c \ge A\min_c \quad ...(3)$$

$$A_c \le \max_c \quad ...(4)$$

$$A_c \ge O \quad ...(6)$$

Objective function: Maximization of net income (equation1)

Y_c denotes yield of a crop c in one hectare of land, P the price received for the output from crop c, C_c refers to the cost incurred to cultivate crop c in one hectare of land and A_c is the area under cultivation of crop c then the RHS of the equation 1 represents sum of net revenue obtained from all the crops considered for the optimum model development. The objective is to maximize the net revenue (z) based on the optimum crop plan.

Equation 2 is considered as land constraint for one year. Equation 2 is a compact form of 12 equations one for each month as shown below. This helps to have separate sown area for each month and ensures that total cultivated area under selected crops in each month should be less than net sown area (NS_t)

$$\sum_c \alpha_{Jan\ c} A_c \le NS_{Jan} - OA_{Jan}$$
$$\sum_c \alpha_{Feb\ c} A_c \le NS_{Feb} - OA_{Feb}$$
$$\sum_c \alpha_{Mar\ c} A_c \le NS_{Mar} - OA_{Mar}$$
$$\sum_c \alpha_{Apr\ c} A_c \le NS_{Apr} - OA_{Apr}$$
$$\sum_c \alpha_{May\ c} A_c \le NS_{May} - OA_{May}$$
$$\sum_c \alpha_{Jun\ c} A_c \le NS_{Jun} - OA_{Jun}$$
$$\sum_c \alpha_{Jul\ c} A_c \le NS_{Jul} - OA_{Jil}$$
$$\sum_c \alpha_{Aug\ c} A_c \le NS_{Aug} - OA_{Aug}$$
$$\sum_c \alpha_{Sep\ c} A_c \le NS_{Sep} - OA_{Sep}$$
$$\sum_c \alpha_{Oct\ c} A_c \le NS_{Oct} - OA_{Oct}$$
$$\sum_c \alpha_{Nov\ c} A_c \le NS_{Nov} - OA_{Nov}$$
$$\sum_c \alpha_{Dec\ c} A_c \le NS_{Dec} - OA_{Dec}$$

Minimum and maximum constraints (equation 3-4)

Crop planning model using LP primarily captures the supply side behavior specifically area response based on net returns and resource constraints ignoring the demand aspect. Such models tend to over-estimate or under-estimate the area allocations for some crops. As a consequence, a single crop may cover infeasible larger area (over-estimation) or null or negligible area (under-estimation).

To avoid such undesirable over-estimation or under-estimation, assigning values to minimum and maximum area of the selected crops becomes essential in model. To eliminate such practically undesirable solutions, concept of min, max constraints is used in the model as specified by the equations 3-4.

The optimum crop model for Assam was estimated under four different situations in the present study. They were as followed:

- The Existing irrigated area of the state
- 5 per cent of net sown area of the state as irrigated area
- 10 per cent of net sown area of the state as irrigated area
- 20 per cent of net sown area of the state as irrigated area (justification is needed)

RESULTS AND DISCUSSION

For estimation of optimum crop model for Assam, at first the optimum crop model for all six zones was estimated individually. Finally all the plans were combined by summing up the optimum area obtained for all those zones and prepared a consolidated optimum crop plan for the whole state.

Table 1 shows the optimum area allocations for different crops separately for different prices under existing irrigated area, 5per cent, 10 per cent and 20 per cent of net sown area as irrigated area. Direction of change (as shown in Table 1) indicates the changing pattern in optimum area over existing area under the three price scenarios. It was

Table 1: Optimum crop model for total area under selected crops of Assam.

Crops	Existing total area (000 ha)	Optimum area (000 ha)with												Direction of change
		Existing IRA			5% of NSA as IRA			10% of NSA as IRA			20% of NSA as IRA			
		MP	EP	NRV	MP	EP	NRV	MP	EP	NRV	MP	EP	NRV	
Autumn Rice	329.68	366.04	366.04	366.04	371.88	371.88	371.88	385.44	385.44	385.44	395.84	395.84	395.84	+++
Winter Rice	1823.86	1887.60	1888.37	1875.12	1871.42	1872.35	1855.83	1901.68	1902.42	1889.50	1900.05	1900.71	1885.72	+++
Summer Rice	396.61	499.30	499.30	499.30	499.41	499.41	499.41	473.27	473.27	473.27	503.69	503.69	503.69	+++
Wheat	52.42	66.92	66.92	66.92	66.74	66.74	66.74	71.75	71.75	71.75	72.79	72.79	72.79	+++
Maize	19.63	26.46	26.46	26.46	25.29	25.29	25.29	27.06	27.06	27.06	27.43	27.43	27.43	+++
Jute	63.77	82.18	82.18	82.18	81.78	81.78	81.78	83.91	83.91	83.91	88.94	88.94	88.94	+++
Mustard	246.25	313.04	313.04	313.04	320.76	320.76	320.76	339.57	339.57	339.57	343.06	343.06	343.06	+++
Sesamum	11.76	12.65	12.65	13.60	12.55	12.55	15.33	12.77	12.77	13.97	13.07	13.07	14.59	+++
Blackgram	46.07	48.24	48.42	58.19	49.54	49.54	60.40	50.83	50.83	60.19	52.81	52.95	63.82	+++
Greengram	8.27	7.49	7.49	9.17	7.83	7.83	9.69	8.16	8.16	9.70	8.10	8.10	9.97	—+
Pea	22.21	28.24	28.24	28.24	28.83	28.83	28.83	29.59	29.59	29.59	30.13	30.13	30.13	+++
Lentil	23.56	29.69	29.69	29.69	29.86	29.86	29.86	31.17	31.17	31.17	31.77	31.77	31.77	+++
Chillies	17.96	22.64	22.64	22.64	22.79	22.79	22.79	23.65	23.65	23.65	24.14	24.14	24.14	+++
Potato	83.82	105.34	105.34	105.34	107.51	107.51	107.51	110.37	110.36	110.36	112.82	112.82	112.82	+++
Sugarcane	28.45	37.48	37.48	37.48	36.37	36.37	36.37	38.63	38.63	38.63	39.21	39.21	39.21	+++
Cabbage	30.36	38.24	38.24	38.24	38.89	38.89	38.89	40.59	40.59	40.59	41.23	41.23	41.23	+++
Cauliflower	20.77	26.19	26.19	26.19	26.60	26.60	26.60	27.70	27.70	27.70	28.21	28.21	28.21	+++
Brinjal	16.16	20.38	20.38	20.38	20.75	20.75	20.75	21.55	21.55	21.55	21.95	21.95	21.95	+++
Tomato	16.47	20.78	20.78	20.78	21.09	21.09	21.09	21.96	21.96	21.96	22.37	22.37	22.37	+++
Okra	11.02	13.26	13.26	13.26	13.72	13.72	13.72	13.90	13.90	13.90	14.54	14.54	14.54	+++
Onion	6.84	8.56	7.61	8.47	8.59	7.66	8.67	8.78	8.05	8.87	9.14	8.33	9.07	+++
Ginger	16.03	19.90	19.90	19.90	19.88	19.88	19.88	20.78	20.78	20.78	21.26	21.26	21.26	+++
Turmeric	14.42	17.52	17.52	17.52	18.00	18.00	18.00	18.45	18.45	18.45	19.17	19.17	19.17	+++
Gross cropped area	3306.39	3698.14	3698.14	3698.14	3700.06	3700.06	3700.06	3761.55	3761.55	3761.56	3821.72	3821.72	3821.72	+++
Net Sown area	2503	2503.00	2503.00	2503.00	2503.00	2503.00	2503.00	2503.00	2503.00	2503.00	2503.00	2503.00	2503.00	No change
Cropping intensity	132.10	147.75	147.75	147.75	147.83	147.83	147.83	150.28	150.28	150.28	152.69	152.69	152.69	+++

IRA= Irrigated Area, MP=Market Price, EP= Economic Price, NRV= Natural Resource Valution.

observed that cropping pattern was almost similar in all the three price scenarios but for all four situations optimum areas were higher than existing areas under all crops except green gram. For green gram, optimum area under market price and economic price situations were lesser than existing area. But under Natural resource valuation, optimum area was higher than existing area for all four situations. Again, it was to be noted that area tend to further increase under all three price scenarios with increased per cent share of net sown area as Irrigated area for all crops. Higher gross cropped area as well as higher cropping intensity were reported as compare to existing ones in optimum plan and those were found to be increased as the per cent share of NSA as irrigated area increased. Therefore, from the resulted optimum crop model it can be concluded that, the areas under almost all the major crops grown in Assam have the scope to be increased under the land constraint of the state both in existing and improved irrigated situation and to contribute more in farm income. the result as shown in table it can be concluded that, beside rice, these crops like maize, sugarcane jute, mustard, pea and vegetables like tomato, brinjal, cauliflower, chilies etc should be seen as potential crops in a profitable crop plan for the state.

Table 2 shows the per cent share of all the crops to the gross cropped area both for existing and optimum crop scenario. Out of all crops winter rice occupied the highest share in gross cropped area. However that share had gradually decreased under optimum plans. Jain *et al.,* (2017) also revealed in their study, that the area under paddy, a water intensive crop, has reduced from 7 to 59 per cent in different optimal crop plans. Most of the other crops accounted for increased per cent share of gross cropped area in optimum plans. But in case of black gram, green gram and sesame per cent shares to the gross cropped area were estimated to be decreased in optimum plans as compared to the existing crop situation.

Table 3 shows the important crops of Assam to be preferred as shown from the optimum plan. It is noted that the ranking of crops as shown in the table has been done on the basis of per cent increase in area under the selected crops in optimum plan [optimum plan for existing Irrigated area (IRA) over their existing area. From the table it is shown that maize occupied the 1st rank followed by sugarcane and jute for the optimum plan for existing irrigated area situation. But for both the situation of 5% and 10% of net sown area as irrigated area, mustard occupied the 1st rank. Besides these, pea, tomato, brinjal, cauliflower, chilies also took better place in the optimum crop plan. It was observed that all three type of rice specially winter rice was not recommended as important crop for Assam. It may be due to higher level of green house gas emission through rice cultivation (Peoples *et al.* (1995); IIPR (2003), IARI (2014), GHG emission from Indian Agriculture: Trends, Mitigation and Policy needs, IARI). But it is also true that rice is the staple food of Assam and therefore rice cannot be replaced or dropped from the crop plan of Assam for food security reasons. So from the result as shown in table it can be concluded that, beside rice, these crops like maize, sugarcane jute, mustard, pea and vegetables like tomato, brinjal, cauliflower, chilies etc should be seen as potential crops in a profitable crop plan for the state.

Gain due to optimum crop model over existing scenario for Assam is shown in Table 4. From the table it can be seen that, change in gross cropped area in optimum

Table 2: Per cent share of crops to gross cropped area under existing and optimum plan of Assam.

Crops	Existing total area(000 ha)	Optimum area with			
		Existing IRA	5% of NSA as IRA	10% of NSA as IRA	20% of NSA as IRA
Winter Rice	55.16	51.04	50.58	50.56	49.72
Summer Rice	12.00	13.50	13.50	12.58	13.18
Autumn Rice	9.97	9.90	10.05	10.25	10.36
Mustard	7.45	8.46	8.67	9.03	8.98
Potato	2.54	2.85	2.91	2.93	2.95
Jute	1.93	2.22	2.21	2.23	2.33
Wheat	1.59	1.81	1.80	1.91	1.90
Blackgram	1.39	1.30	1.34	1.35	1.38
Cabbage	0.92	1.03	1.05	1.08	1.08
Sugarcane	0.86	1.01	0.98	1.03	1.03
Lentil	0.71	0.80	0.81	0.83	0.83
Pea	0.67	0.76	0.78	0.79	0.79
Cauliflower	0.63	0.71	0.72	0.74	0.74
Maize	0.59	0.72	0.68	0.72	0.72
Chillies	0.54	0.61	0.62	0.63	0.63
Tomato	0.50	0.56	0.57	0.58	0.59
Brinjal	0.49	0.55	0.56	0.57	0.57
Ginger	0.48	0.54	0.54	0.55	0.56
Turmeric	0.44	0.47	0.49	0.49	0.50
Sesame	0.36	0.34	0.34	0.34	0.34
Okra	0.33	0.36	0.37	0.37	0.38
Greengram	0.25	0.20	0.21	0.22	0.21
Onion	0.21	0.23	0.23	0.23	0.24

IRA=Irrigated Area, NSA=Net Sown Area.

plan over existing plan has gradually increased as the per cent share of irrigated area to net sown area was increased. The highest per cent increase (15.59%) in Gross cropped area was found under the situation of 20 per cent of Net sown area as irrigated area. Therefore, the highest net gain from the optimum plan was also found under the same situation.

Suggestion and Policy Implication

The above study found that there is still scope for increase in area under suitable crops which can be commercially cultivated in the rice field which remains fellow after winter rice cultivation. From study, some important crops for Assam such as maize, sugarcane, jute, pea, mustard are indentified. Beside these, some other potential crops like king chilli (locally known as bhut jolokia) need to be identified and more area should be allocated to these crops. Cropping intensity can be increased through creation of irrigation facility and proper utilization of those facilities along with introduction of improved crop varieties. It would

Table 3: Rank wise per cent increase in area in optimum plan over existing area under selected crops of Assam.

Rank	Crops	Existing IRA	5% of NSA as IRA	10% of NSA as IRA	20% of NSA as IRA
1	Maize	34.79	28.83	37.85	39.74
2	Sugarcane	31.74	27.84	35.78	37.82
3	Jute	28.87	28.24	31.58	39.47
4	Wheat	27.66	27.32	36.88	38.86
5	Pea	27.15	29.81	33.23	35.66
6	Mustard	27.12	30.26	37.90	39.31
7	Tomato	26.17	28.05	33.33	35.82
8	Brinjal	26.11	28.40	33.35	35.83
9	Cauliflower	26.10	28.07	33.37	35.82
10	Chillies	26.06	26.89	31.68	34.41
11	Lentil	26.02	26.74	32.30	34.85
12	Cabbage	25.96	28.10	33.70	35.80
13	Summer Rice	25.89	25.92	19.33	27.00
14	Potato	25.67	28.26	31.68	34.60
15	Onion	25.15	25.58	28.36	33.63
16	Ginger	24.14	24.02	29.63	32.63
17	Turmeric	21.50	24.83	27.95	32.94
18	Okra	20.33	24.50	26.13	31.94
19	Autumn Rice	11.03	12.80	16.91	20.07
20	Sesamum	7.57	6.72	8.59	11.14
21	Blackgram	4.71	7.53	10.33	14.63
22	Winter Rice	3.49	2.61	4.27	4.18
23	Greengram	-9.43	-5.32	-1.33	-2.06

IRA=Irrigated Area, NSA=Net Sown Area.

Table 4: Gain due to optimum crop model over existing scenario for Assam.

Situation (1)	Optimum Scenario (2)	Change in GCA % (3)	Existing net return (crores) (4)	Optimal net returns (crore) (5)	Change in farmer revenue (crore) (optimal-Existing$_{MP}$) (6)	Gain to society (crore) (7)	Net gain (crore) (8)= (6)+(7)
Existing irrigated area	Market price	11.85	3443.72	3976.61	532.89	-	532.89
	Economic price	11.85	3023.33	3488.73	45.01	420.39	465.40
	Natural resource	11.85	1884.88	2262.68	-1181.04	1558.84	377.80
5% of NSA as Irrigated area	Market price	11.91	3443.72	4007.43	563.71	-	563.71
	Economic price	11.91	3023.33	3517.86	74.14	420.39	494.53
	Natural resource	11.91	1884.88	2298.62	-1145.10	1558.84	413.74
10% of NSA as Irrigated area	Market price	13.77	3443.72	4110.13	666.41	-	666.41
	Economic price	13.77	3023.33	3617.22	173.50	420.39	593.89
	Natural resource	13.77	1884.88	2387.34	-1056.38	1558.84	502.46
20% of NSA as Irrigated area	Market price	15.59	3443.72	4282.92	839.20	-	839.20
	Economic price	15.59	3023.33	3776.64	332.92	420.39	753.31
	Natural resource	15.59	1884.88	2531.17	-912.55	1558.84	646.29

NSA=Net Sown Area, GCA= Gross Cropped Area.

be appropriate if the crop plan could have been developed according to land situation. The advantages of the centrally sponsored schemes need to be explored so that farmers' income can be enhanced.

CONCLUSION

As suggested by the optimum crop plan, there is urgent need to create more irrigation facility so as to increase the yield and production. Further market potential for marketing of additional produced has to be explored. Proper coordination between different stakeholders such as department of agriculture, department of irrigation, state marketing board and finance department has to be pronounced.

ACKNOWLEDGEMENT

The paper is a part of ICAR-NIAP funded project on Regional Crop Planning for Improving Resource Use Efficiency and Sustainability. The authors would like to acknowledge the financial and technical help received form ICAR- NIAP.

REFERENCES

Comprehensive Scheme for Cost of Cultivation (CCS) of Principal Crops of Directorate of Economics and Statistics, Ministry of Agriculture.

Economic Survey of Assam (2014-15). Directorate of Economics and Statistics, Ministry of Agriculture, Government of Assam.

Indian Agricultural Research Institute (2014). GHG emission from Indian Agriculture: Trends, Mitigation and Policy needs, IARI, New Delhi.

Jain, R., Raju, S.S., Immaneulraj, K., Srivastava, S.K., Kaur, A. P. and Singh, J. (2015). Manual on Methodological Approach for Developing Regional Crop Plan.ICAR-National Institute of Agricultural Economics and Policy Research, New Delhi.

Jain, R., Immaneulraj, K., Chand, R., Kaur, A. P, Raju, S.S, Srivastava, S.K and Singh, J (2017). Farmers and social perspective on optimal crop planning for ground water sustainability: A case of Punjab state in India Journal of the Indian Society of Agricultural Statistics. 71(1) 75–88.

Paidipati, K. K., and Padi, T. R. (2017). Optimal Programming Problems for Crop Planning and Agricultural Resource Management. Archives of Business Research. 5(12): 282-293.

Peoples, M.B.; Herridge, D.F. and Ladha J.K. (1995). Biological nitrogen fixation: An efficient source of nitrogen for sustainable agricultural production? Plant and Soil. 174: 3–28.

Raju, S.S., Chand, R., Srivastava, S.K., Kaur, Amrit Pal, Singh, Jaspal, Jain, Rajni, Immaneulraj, Kingsly and Kaur, Parminder (2015). Comparing performance of various crops in Punjab based on market and economic prices and natural resource accounting. J. Agric. Eco. Res. Rev., 28(Conference Number), 189-198.

Wankhade M.O. and Lunge H.S. (2012). Allocation of Agricultural Land to the Major Crops of Saline Track by Linear Programming Approach: A Case Study. International Journal of Scientific & Technology Research. 1(9).

Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of the license, visit http://creativecommons.org/licenses/by/4.0/©. The Author(s) 2019

ISSN: 0976-0539 (Online), 0253-1496 (Print), Naas Rating: 4.37