

RECENT CHALLENGES AND FUTURE SUSTAINABILITY OF POTATO CULTIVATION IN HUGLI DISTRICT, WEST BENGAL: A GEOGRAPHICAL APPRAISAL USING SWOT-AHP ANALYSIS

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ABSTRACT: The prime goal of the present study is to ascertain suitable strategies regarding the sustainable and effective growth of potato cultivation in Hugli district of West Bengal by examining the Strengths (S), Weaknesses (W), Opportunities (O) and Threats (T) of the system through a combination of SWOT analysis and Analytical Hierarchy Process. The result reveals that constant year round demand of potato (S5, 0.25) and increasing expenditure costs (W3, 0.25) are the most prioritized internal strength and weakness respectively. On the contrary, large scale employment generation (O6, 0.29) for the locals as well as the migrant laborers is the most prioritized external opportunity, whereas, oscillating nature of economic profitability (T2, 0.27) is the most prioritized external threat of potato cultivation in the area. The overall priority scores of SWOT analysis exhibits that steady demand of potato throughout the year (S5) possesses the most significant (9.7%) aspect among all the internal and external factors. In conclusion, appropriate strategies have been formulated by linking the most prioritized 'strength-opportunity' and 'weakness-threat' factors for future possibilities of the potato cultivation in Hugli district of West Bengal.

KEYWORDS: Potato, SWOT Analysis, Analytic Hierarchy Process, Hugli

INTRODUCTION

Endowed with suitable agro-ecological conditions, the Hugli district has acclaimed a remarkable position in potato (*Solanum tuberosum*) cultivation since the 1970s with massive production and superior productivity in comparison to the other districts of West Bengal (Mookherjee *et al.*, 2012). Being introduced as a food crop, the potato has briskly emerged as the prime cash crop in the area on account of the substantial demand, which has persuaded the farmers to shift to potato cultivation (Ghosh, 2017). Since then potato has become the principal choice of the farmers due to higher profitability. Within a very short period of time the crop has proved its importance in the rural economy. More

than 1/3rd of the geographical area and almost 3/4th farmers of the district are engaged in potato cultivation (Ghosh, 2017). Despite significant spatio-temporal dynamicity in the area, production and yield, potato has retained its superiority in the larger part of the district, even ahead of paddy due to its capability to compensate the loss incurred by other crops (Roy *et al.*, 2019). At present, the district holds a leading position in production and export of potato to the nearby districts as well as states. Such constant expansion of market and increment in demand lead towards the escalation of production volume and greater involvement of arable land, labour and capital. Recent developments of infrastructural facilities like quality roads and cold storages, encouraging governmental

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policies have added extra impetus for success of potato cultivation in the district (Ghosh, 2017).

Despite the present flourishing state with a wider scope of future prosperity, potato cultivation in the district has experienced diverse physical, economic and policy oriented problems affecting the production, marketing and pricing of potato. The economic state of the potato growers, especially the small and marginal farmers, *bargadars* and share croppers, often encountered with uncertainty and disheartened them to grow potato. Such adverse circumstances have hindered the overall consistency of potato farming in recent days. Therefore, it is necessary to formulate suitable strategies for future sustainability through proper understanding of the functionality of potato farming in the area. In such context, the present study strives to examine the potency and flaws of the existing farming system in the area, explore the future opportunities as well as ascertain the upcoming threats and finally determine

the suitable strategy for future sustainability of potato cultivation in the district using SWOT-AHP analysis.

MATERIALS AND METHODS

The study area

The Hugli district is located in the south-central region of the state of West Bengal along the western bank of River Hooghly. The administrative boundaries extend between 23°01'20"N - 22°39'32" N and 88°30'15"E - 87°39'32"E. The district is bounded by the river Hugli in the east, Paschim Medinipur district in the west, Bankura and Purba Bardhaman districts in the north, and Howrah to the south. Located on the flat alluvial plains of lower Gangetic region, the district is served by rivers like Hugli, Damodar, Dwarakeswar, Saraswati etc. and endowed with rich, easily extractable ground water resources (Roy *et al.*, 2019). The district comes under one of the top potato producing districts in West Bengal. Therefore the district has been deliberately selected for the present

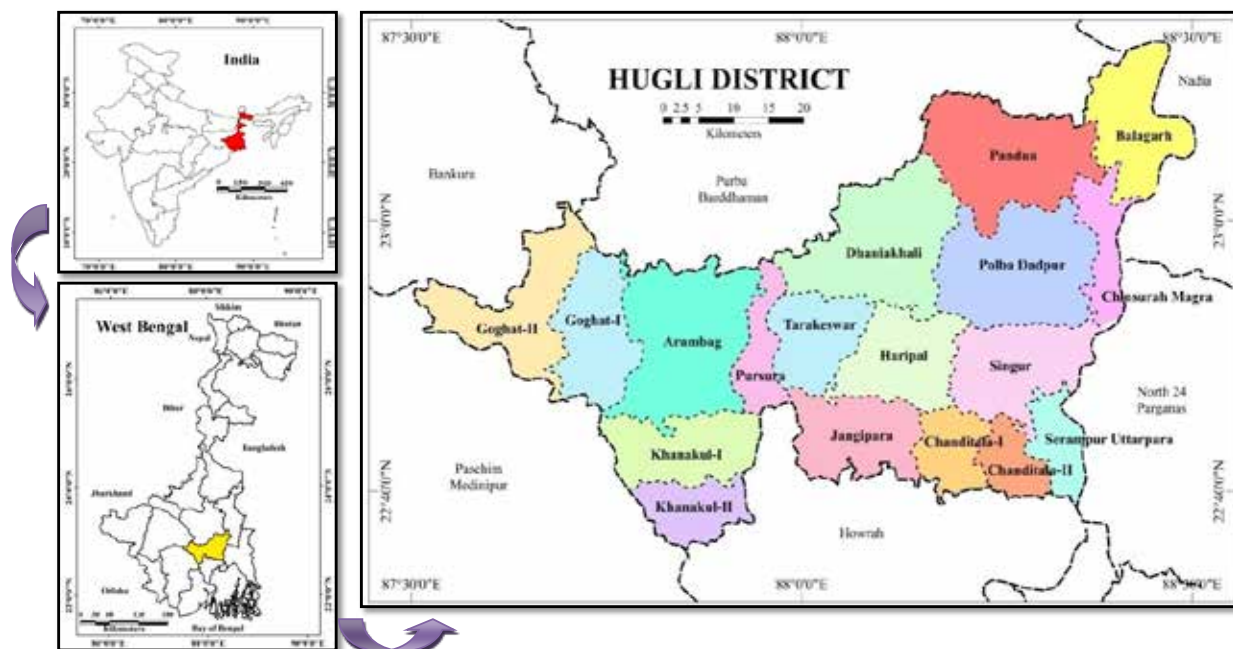


Fig. 1: Location of the Study Area

study. The district lies in the tropical humid monsoon climatic regime with oppressive hot summer, high humidity nearly all the year round and well distributed rainfall during the monsoon season. The district is characterized with three distinct seasons: hot summer, wet monsoon and cold dry winter. May is the hottest month, with the mean daily maximum temperature of 36.7°C and the mean daily minimum temperature at 24.3°C. On the contrary, January is the coldest month with the mean daily maximum temperature of about 26.6°C and the mean daily minimum temperature of about 12.1°C. The cold season starts from the middle of November and continues up to end of February. The average annual rainfall in the district is 1418.5 mm. The maximum rainfall occurs during the southwest monsoon season. Nearly 76% of the annual rainfall occurs during June to September. The relative humidity reaches above 90% in August and recedes to as low as 78% in April-May (IMD, 2008).

Sources and nature of data

The present study is based on the primary data, obtained through intensive field investigation and direct interaction with the stakeholders. Both personal interaction and focus group discussions (FGDs) were conducted to appraise individual to community perception concerning the pros and cons of the present management of potato from cultivation to marketing. For this purpose, 60 farmers, 72 *bargadars* (including share croppers and contract farmers), 80 casual labourers (engaged in harvesting, grading, sorting, packaging, preserving, transportation etc.), 40 wholesalers (or agents/ intermediaries/ middlemen), 40 retailers, 30 women workers (engaged in industries of potato chips, potato powder making) and 5 cold storage owners are interviewed with semi-structured questionnaire, containing both open ended and close ended questions. All the respondents

were selected through random sampling techniques and the interview session was conducted during the harvesting seasons of 2019-2020. Among the 60 sampled cultivators, eight farmers are large farmers (having > 4 hectares of land), 12 are medium (2-4 hectare), 14 small (1-2 hectare) and 26 marginal (< 1 hectare) farmers. Furthermore, four focus group discussions (FGDs), involving 12 stakeholders in each group (engaged in potato farming for at least 40 years) have been conducted to acquire information regarding the evolution and changing aspects of potato production system in the district.

1. SWOT-AHP Analysis

Introduced by Albert Humphrey in 1960s, the SWOT model comprises an effective decision making model by analyzing two prevailing or internal factors i.e. strengths (S) and weaknesses (W), and two upcoming or external factors i.e., opportunities (O) and threats (T) of any system (Gürel and Tat, 2017). This effective strategic tool has been used in the present study accompanying with the Analytical Hierarchy Process (AHP) to understand the determinants and their inter-connections and to formulate the strategies for future sustainability of potato cultivation. The influencing internal and external factors of potato cultivation in the study area has been highlighted in Table 1.

The Analytical Hierarchy Process (AHP) is one of the most efficient multi-criteria decision making technique (MCDM) which has widely been used to solve many real problems (Oreski, 2012). In this mathematical model, the alternatives in each category of SWOT matrix are ranked according to a certain weight based on their relative importance (Görener *et al.*, 2012). The criteria weights of each SWOT elements are assigned by using Saaty's fundamental scale (1980) which denotes the relative intensity of

Table 1: Identified internal and external factors of SWOT analysis

Strengths (S)	Weaknesses (W)
S1 Favorable agro-climatic conditions	W1 Climatic variability
S2 High cropping intensity	W2 Prevalence of biotic hazards
S3 Long experience of potato cultivation (more than 40 years)	W3 Increasing expenditure costs and decreasing profit
S4 Short duration crop that fits well within the prevailing cropping system	W4 Economically weak small and marginal farmers
S5 Continuity in demand throughout the year	W5 Irregularities in market and dominance of the middlemen (artificial crisis in the market)
S6 Availability of local labour forces	W6 Lack of infrastructural facilities (i.e. transport facilities, cold storages etc.)
S7 Farmer's willingness and massive engagement	W7 Shortage of capital and growing dependency on bank and money lenders
	W8 The absence of proper government policy and administrative control
Opportunities (O)	Threats (T)
O1 Extension of agro based and food processing industries	T1 Occurrences of crop failures
O2 Cultivation of different varieties of potato	T2 Fluctuation in economic profitability
O3 Expansion of agricultural markets and escalation in demand	T3 Over production and declining market prices
O4 Implementation of suitable policies regarding storing (like <i>Kishan Mandi</i>), marketing and trading	T4 Shifting of farmers from potato to other crops
O5 Improvement in infrastructural facilities	T5 Depletion of ground water level
O6 Large scale employment opportunities for the locals and the migrant labourers	T6 Deterioration of soil quality owing to excessive use of chemical fertilizers, pesticides etc and risk of biomagnifications
O7 Establishment and efficient management of large scale farms and participatory management system	T7 Recent changes in climate

importance between two alternative factors (Sharma *et al.* 2008).

The pair-wise comparison matrix, resembling to square and reciprocal matrix of each factor within each group, is computed by using the following equation to measure the relative priorities and find out the most influential elements (Alonso and Lamata, 2006). In this matrix, every element is a_{ij} ($i, j = 1, 2, \dots, n$) the quotient weight of the criteria where the value of w_i vary from 1 to 9.

$$A = [a_{ij}] = \begin{pmatrix} 1 & a_{12} & \dots & a_{1j} & \dots & a_{1n} \\ 1/a_{12} & 1 & \dots & a_{2j} & \dots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots & \ddots & \vdots \\ 1/a_{1j} & 1/a_{2j} & \dots & 1 & \dots & a_{in} \\ \vdots & \vdots & \ddots & \vdots & \ddots & \vdots \\ 1/a_{1n} & 1/a_{2n} & \dots & 1/a_i & \dots & 1 \end{pmatrix}$$

In the next step, each matrix is normalized to compute the relative weights by multiplying

the actual eigen vector (w) with corresponding largest eigen value (λ_{max}), following the equation below (Lee and Walsh, 2011):

$$Aw = \lambda_{max}W$$

Then, the **Consistency Index (CI)** is calculated by using the following formula (Sharma *et al.*, 2008):

$$CI = \frac{\lambda_{max} - n}{n - 1}$$

The **Consistency Ratio (CR)** helps measure the consistency of the result of pair-wise comparison in AHP where 0.1 refers to the accepted upper limit of CR. If the final Consistency Ratio exceeds this threshold value, then it indicates the inconsistency and the whole evaluation process needs to be repeated to improve the consistency

(Ergu *et al.*, 2011). The Consistency Ratio is determined from the ratio between the **Consistency Index (CI)** and **Random Index (RI)** which is as follows (Borajee and Yakchali, 2011):

$$CR = \frac{CI}{RI}$$

The overall priority of the SWOT factor have been computed by multiplying the priority of the factor within the group by the priority of the group (Kurttila *et al.*, 2000).

2. Formulation of strategic planning

A multi-criterion strategic framework has been prepared for effective decision making in futuristic developments of potato production by linking the most prioritized S-O and W-T factors. The perception based empirical approach has been followed here to link the most prioritized six positive factors and six negative factors to formulate the strategies.

- (a) **Strength-Opportunity (SO):** SO strategy connects the most prioritized three internal strenghts with three external oppoutunities to enhance the prospect of potato production
- (b) **Weakness-Threat (WT):** WT strategy links the most prioritized three internal weaknesses with three external threats

that suggests the alternative action planning to combat the major risks and shortcomings of potato production

The strategy having the highest recognition from respondents has been chosen as the best potential strategy for future sustainability and development of potato farming in the district. The views of the respondents have been collected by perception survey through a rating scale, classified into three categories i.e. **agree**, **disagree** and **neutral** (Chakraborty and Chakma, 2020).

RESULTS AND DISCUSSION

Analysis of the SWOT factors

The Comparison Matrix of strength factors (Table 2) reveals that permanence in demand round the year (S5, importance degree value: 0.25) is the highest strength of potato production in the studied district followed by favorable agro-climatic conditions (S1, value: 0.23), and high cropping intensity and production rate (S2, value: 0.18). The demand of potato as cheap source of starch has every prospect to sustain long rather will increase with its use as different varieties of food items. The usage of potato in traditional Bengali diet is highly appreciated due to its taste, good nutrition value and affordable price. Naturally, there is a consistent demand

Table 2: Comparison matrix of strength group

Strengths (S)	S1	S2	S3	S4	S5	S6	S7	Importance Degrees
S1 Favorable agro-climatic conditions	1.00	3.00	3.00	2.00	0.33	2.00	5.00	0.23
S2 High cropping intensity and production rate	0.33	1.00	2.00	2.00	1.00	3.00	4.00	0.18
S3 Long experience of potato cultivators (more than 40 years)	0.33	0.50	1.00	1.00	0.50	3.00	3.00	0.12
S4 Short duration crop that fits well within the prevailing cropping system	0.50	0.50	1.00	1.00	0.50	2.00	3.00	0.11
S5 Continuity in demand throughout the year	3.00	1.00	2.00	2.00	1.00	3.00	4.00	0.25
S6 Availability of local labour forces	0.50	0.33	0.33	0.50	0.33	1.00	4.00	0.08
S7 Farmer's willingness and massive engagement	0.20	0.25	0.33	0.33	0.25	0.25	1.00	0.04
C.R = 0.07								

of potato in household level for consumption in daily basis *which assumes that the internal demand is expected to be in an inflated state*. Recent rapid booming of urbanization in the eastern margin of the district along the right bank of the river Hugli and consequent increment in number of census towns during the last decade (Siddique and Mukherjee, 2017) has enhanced the demand. Besides, the increasing commercial demand in newly flourished food-processing units in and around the district has enhanced the demand side. As the area under review is located close to the Kolkata metropolitan city and Haora, the area experiences a steady demand of potato. In addition, potatoes from this belt have been exported to the neighboring states also. Such escalated demands promises greater possibility of prosperity in production in near or distant future to meet the growing demands. Concurrently, the crop has huge potentiality to cope up with the increased food demand and poverty alleviation. The need for assured food security to the ever growing population with limited availability of cultivable land has necessitated spatio-temporal intensification of cropping. As a short duration cash crop, potato has easily accustomed with the existing cropping system and shows notable capability of adjustment with the changes in the system. Moreover, the crop has revealed its greater suitability in the varied agro-climatic conditions of the district. According to the Comprehensive District Agricultural Plan (CDAP) Report (2012) and Agricultural Technology Management Agency (ATMA) Report (2005-06) the district can be divided into three distinct agro-ecological situation zones (AES), of which AES I and II, covering nearly 83.77% of the district's area, are extensively suitable for potato cultivation. Almost 65.04% area under these two zones has already been used for potato farming. Even 21.62% area in AES III where monoculture

has been practiced, is also engaged in potato cultivation (Ghosh, 2017). In a nutshell, it may be said that the physical environment of the district is not a barrier; rather it provides an extensive field for potato farming.

The Table 3 has shown the comparison matrix of weakness aspects of the system. The analysis reveals that increasing expenditure costs and decreasing profit (W3, importance degree value: 0.25) are the most dominating weaknesses of the persisting agricultural system of the area. The cost of each component of agricultural input like chemical fertilizers, pesticides, labour, HYV seeds etc. along with transportation, irrigation, cold storage facilities has conspicuously increased over the past years. Field survey has revealed that the cost of chemical fertilizers and pesticides has been increased nearly 136.45% and 41.67% respectively from 2000 to 2019. Similarly, the cost of HYV seeds is risen about 68.75%, labour cost is increased nearly 160%, and irrigation cost is enhanced up to 200% during the stipulated phase. Overall, the estimated production cost per hectare area has been incremented to 111% during past twenty years. On an average, the irrigation cost comprises almost 9.47% of the total cost in 2019-20. As a *rabi* crop, potato is generally cultivated in the district during the dry months of the winter (October-February). Naturally, potato cultivation has to depend upon irrigation water. Therefore, huge amount of ground water has been extensively extracted through deep, shallow or submersible pumps for irrigation purpose, which has alarmingly reduced the level of ground water table. The rising production expenditure naturally reduces the profit of the producers. Most notable fact is that, the economic return from the field has failed to keep pace with mounting production cost over the past years. Even in a number of cases, the farmers have failed to recover their

Table 3: Comparison matrix of weakness group

Weaknesses (W)	W1	W2	W3	W4	W5	W6	W7	W8	Importance Degree
W1 Climatic variability	1.00	2.00	0.33	0.50	1.00	4.00	3.00	3.00	0.15
W2 Prevalence of biotic hazards	0.50	1.00	0.50	1.00	0.50	3.00	2.00	3.00	0.12
W3 Increasing expenditure costs and decreasing profit	3.00	2.00	1.00	2.00	2.00	3.00	3.00	4.00	0.25
W4 Economically weak small and marginal farmers	2.00	1.00	0.50	1.00	0.33	3.00	2.00	2.00	0.13
W5 Irregularities in market and dominance of the middlemen	1.00	2.00	0.50	3.00	1.00	3.00	1.00	3.00	0.17
W6 Lack of infrastructural facilities	0.25	0.33	0.33	0.33	0.33	1.00	0.33	1.00	0.05
W7 Shortage of capital and growing dependency on bank and money lenders	0.33	0.50	0.33	0.50	1.00	3.00	1.00	2.00	0.09
W8 The absence of proper government policy and administrative control	0.33	0.33	0.25	0.50	0.33	1.00	0.50	1.00	0.05
CR = 0.05									

investments. Under such circumstances, the small and marginal farmers have become most vulnerable due to their incapability to combat the economic loss and sustain their livelihoods properly. They prefer loans from local money lenders [*Mahajans*] with high rate of interest (ranging from 10% to 15% per month during 2019-2020) to compensate for the loss and further beginning of cultivation and ultimately get trapped in debt. Thus the profit from the field of the potato growers gradually decreases which acts as a major economic constraints for potato cultivation.

Apart from this, the irregularities in market owing to the tricks of the middlemen (W5, value: 0.167), and climatic variability (W1, value: 0.15) are found to be another two most influencing internal weakness factors. The artificial crisis of potato in the market are often created by the middlemen (*forias*, *aratdars*) and the distributors for pocketing the benefit of inflated price where the economically weak small and marginal farmers are forced to sell the product at lower prices just after harvest and the middlemen multiply their profit each year. Due to the economic insolvency, the small and marginal

farmers often sell the crop from the field at a cheap cost in order to save the storage cost as the harvested products are non-preservable, easily rotten and damaged by diverse diseases.

The labour intensive nature of farming in the area with less use of modern machineries generates a huge demand of skilled and unskilled labourers in different stages from field preparation to marketing of potato. The greater potentialities of major agro-based industrial sector may create a wide scope of employment opportunities in near future. A bulk of poor fellow from the nearby rural areas or even from the neighboring districts migrate as agricultural labourers towards the area during harvesting season. The following comparison matrix of opportunity group (Table 4) reveal that large scale employment generations for the locals as well as for the migrant labourers from the neighboring districts (O6, importance degrees value: 0.29), expansion of agricultural markets and resulted escalation in demand (O3, value: 0.29) and extension of agro based and food processing (like potato powder, potato chips etc) industries (O1, value: 0.137) are the most

Table 4: Comparison matrix of opportunity group

Opportunities (O)	O1	O2	O3	O4	O5	O6	O7	Importance Degrees
O1 Extension of agro based and food processing industries	1.00	3.00	0.30	2.00	2.00	0.00	2.00	0.14
O2 Cultivation of different varieties of potato	3.00	1.00	0.30	0.00	0.50	0.00	2.00	0.07
O3 Expansion of agricultural markets and escalation in demand	3.00	4.00	1.00	3.00	3.00	1.00	2.00	0.23
O4 Implementation of suitable policies regarding storing (like <i>Kishan Mandi</i>), marketing and trading	0.50	3.00	0.30	1.00	3.00	0.00	0.50	0.11
O5 Improvement in infrastructural facilities	0.50	2.00	0.30	0.00	1.00	0.00	0.50	0.07
O6 Large scale employment generations for the locals and for the migrant labourers	3.00	3.00	2.00	3.00	3.00	1.00	3.00	0.29
O7 Establishment and efficient management of large scale farms and participatory management system	0.50	1.00	0.50	2.00	2.00	0.00	1.00	0.10
CR = 0.09								

prioritized opportunities among the seven opportunity factors.

Among the threat factors, the fluctuation in economic profitability (T2, importance degree value: 0.27), occurrences of crop failures (T1, value: 0.22) and depletion of ground water level (T4, value: 0.17) due to excessive irrigation in post-monsoon seasons are found to be the most alarming issues in the district (Table 5). The potato-growers of the district experience oscillation of loss and profit from potato, depending upon the production scale and profit margin, which is adjusted in the share of land under potato for the next year and control the production

volume. The year of higher production is obviously linked to increase in area under potato and resultant fall in price. The farmers experiencing loss in the economy reduce area under potato in the next year leading to reduction in production which causes rise in the price of the crop. It has been found that in every alternative year, the area under potato has shown a trend of rise and fall as in Figure 2 (District Statistical Handbook, 1990-91 - 2013-14; Ghosh, 2017).

The small and marginal farmers are most vulnerable to the frequent oscillation in economic profitability related to the fluctuation in the productivity, expenditure,

Table 5: Comparison matrix of threat group

Threats (T)	T1	T2	T3	T4	T5	T6	T7	Importance Degrees
T1 Occurrences of crop failures	1.00	0.50	2.00	3.00	4.00	3.00	2.00	0.22
T2 Fluctuation in economic profitability	2.00	1.00	3.00	2.00	4.00	4.00	2.00	0.27
T3 Over production and declining market prices	0.50	0.50	3.00	0.50	3.00	3.00	1.00	0.14
T4 Shifting of farmers from potato to other crops	0.25	0.25	0.33	0.25	1.00	0.33	0.33	0.04
T5 Depletion of ground water level	0.33	0.50	2.00	1.00	4.00	4.00	2.00	0.17
T6 Deterioration of soil quality owing to excessive use of chemical fertilizers, pesticides etc and risk of biomagnifications	0.33	0.25	0.33	0.25	3.00	1.00	0.33	0.06
T7 Recent changes in climate	0.50	0.33	1.00	0.50	3.00	3.00	0.33	0.10
CR = 0.06								

market price and profits. In addition, recent changes in climatic phenomena with decreasing length of winter period hinder the natural growth and productivity of potato in the district (Ghosh, 2017). Besides, the extreme but infrequent climatic hazards lead towards prevalence of biotic hazards (fungal, viral and bacterial diseases) and often lead towards crop failure. Such climatic irregularities (winter rains and hailstorm, humidity and temperature fluctuation etc.) put extensive effect on the production volume. For example, winter rainfall in 2005-06, hailstorm in 2006-07, and prevalence of pest diseases in 2008-09, have immensely damaged the potato cultivation across the district (Hatia and Mondal, 2015). Such climatic extremities, irregularities and the associated biotic hazards lead to massive crop failures where the small and marginal farmer are severely affected owing to poverty and lesser adaptive capacity to cope with the situation.

The overall priority scores of the SWOT factors (Table 7) have been derived by multiplying the priority score of each factor within the group with the group priority score (Table 6). The analysis has exhibited that the

incessant demands of potato over the year is the prime important factor in SWOT (S5) having highest overall priority value of 0.097. The ranks of the other considerable factors according to overall priority from each SWOT groups are as follows: large scale employment generations for the locals as well as the migrant labourers (0.10) from opportunity groups, increasing expenditure costs and decreasing profit (0.04) from weakness group, and fluctuation in economic profitability (0.03) from threat groups respectively.

The strategies: Respondents' perception

Strategy I: Strength-Opportunity (SO) strategies

The combination of most prioritized Strength-Opportunity (SO) factors has

Table 6: Pair-wise comparison of SWOT factors

SWOT Groups	S	W	O	T	Group Priority Score
Strengths (S)	1.00	3.00	1.00	4.00	0.40
Weaknesses (W)	0.33	1.00	0.33	2.00	0.15
Opportunities (O)	1.00	3.00	1.00	2.00	0.34
Threats (T)	0.25	0.50	0.50	1.00	0.11
CR = 0.04					

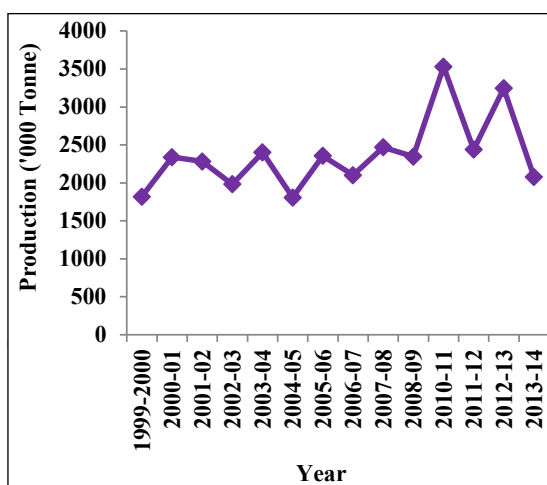
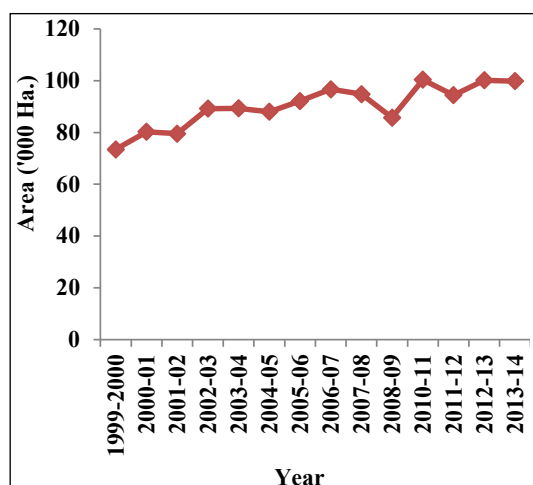


Fig 2: Temporal variation of (A) Area and (B) Production of Potato, Hugli, 1999-2000 to 2013-14

Source: District Statistical Handbook, 1990-91 - 2013-14

Table 7: Overall priority scores of SWOT factors

SWOT Group	Group Priority Score	SWOT Factors	Priority Score of the factors within the Group	Overall Priority Score of factor
Strengths (S)	0.4	S7 Farmer's willingness and massive engagement	0.04	0.02
		S6 Availability of local labour forces	0.08	0.03
		S4 Short duration crop that fits well within the prevailing cropping system	0.11	0.04
		S3 Long experience of potato cultivation (more than 40 years)	0.12	0.05
		S2 High cropping intensity	0.18	0.07
		S1 Favorable agro-climatic conditions	0.23	0.09
		S5 Continuity in demand throughout the year	0.25	0.1
Weaknesses (W)	0.15	W6 Lack of infrastructural facilities (i.e. transport facilities, cold storages etc.)	0.05	0.01
		W7 Shortage of capital and growing dependency on bank and money lenders	0.09	0.01
		W8 The absence of proper government policy and administrative control	0.05	0.01
		W1 Climatic variability	0.15	0.02
		W2 Prevalence of biotic hazards	0.12	0.02
		W4 Economically weak small and marginal farmers	0.13	0.02
		W5 Irregularities in market and dominance of the middleman (artificial crisis in the market)	0.17	0.03
Opportunities (O)	0.34	W3 Increasing expenditure costs and decreasing profit	0.25	0.04
		O2 Cultivation of different varieties of potato	0.07	0.02
		O5 Improvement in infrastructural facilities	0.07	0.02
		O7 Establishment and efficient management of large scale farms and participatory management system	0.1	0.03
		O4 Implementation of suitable policies regarding storing (like <i>Kishan Mandi</i>), marketing and trading	0.11	0.04
		O1 Extension of agro based and food processing industries	0.14	0.05
		O3 Expansion of agricultural markets and escalation in demand	0.23	0.08
Threats (T)	0.11	O6 Large scale employment opportunities for the locals and the migrant labourers	0.29	0.1
		T5 Depletion of ground water level	0.04	0
		T3 Over production and declining market prices	0.1	0.01
		T6 Deterioration of soil quality owing to excessive use of chemical fertilizers, pesticides etc and risk of biomagnifications	0.06	0.01
		T1 Occurrences of crop failures	0.22	0.02
		T4 Shifting of farmers from potato to other crops	0.17	0.02
		T7 Recent changes in climate	0.14	0.02
		T2 Fluctuation in economic profitability	0.27	0.03

pointed out the following strategies for the prosperity of potato cultivation of the district under review:

- **SO1:** The favorable agro-climatic condition (S1) leads to production of large varieties of potatoes, which helps expand the

agricultural markets and further escalation in demand (O3).

- **SO2:** Year round stability in demand (S5) will help sustain, rather expand the production scale, which will create large scale employment opportunity for the

locals as well as for the migrant labourers from the neighboring districts (O6).

- **SO3:** High cropping intensity with high production rate (S2) which will help flourish agro based and food processing industries (O1) in the area like potato powder, potato chips etc.

The analysis of the respondents' opinions has revealed that the second strategy i.e. SO2 has got the highest appreciation from the respondents (nearly 90%). The strategy number three (SO3) has been supported by 82% of the respondents, while SO1 has only 78% support from the stakeholders of the potato farming system in the study area (Fig. 3).

Strategy II: Weakness-Threat (WT) Strategies

Three WT strategies have been organized as effective measures to mitigate the relative weaknesses and threats of potato cultivation. These strategies provide alternative action plans which help to discover the most suitable strategy to combat internal weaknesses and external threats of the potato farming system of the area.

- **WT1:** The climatic variability (W1) will affect the farmers more extensively, as it leads towards greater and frequent possibilities of crop failures (T1). In this

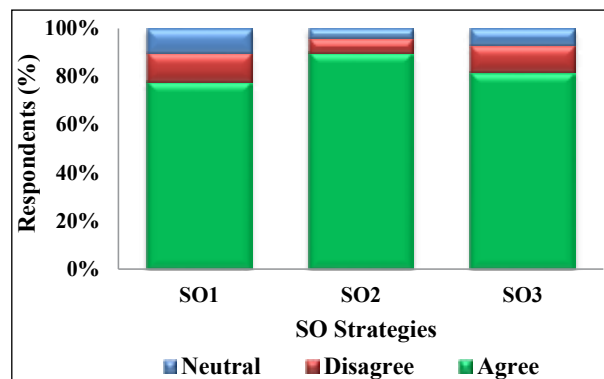


Fig 3: Perception of the respondents for SO Strategies

context, proper implementation of pre and post disaster management strategies with the establishment of infrastructural facilities and provision of financial aids are needed to alleviate the risk. Further, farmer friendly approaches of the government policies and measures (like (Minimum Support Price or MSP, crop insurance such as Restructured Weather Based Crop Insurance or RWBCIS) are also needed to cope up with the loss and damages.

- **WT2:** The artificial crisis of potato in the markets created by the middlemen (*forias, aratdars*) and the distributors (W5) is one of the inevitable and impactful weaknesses within the systems. The small and marginal farmers are most vulnerable to sustain and combat the fluctuation in economic profitability (T2). There is a serious need of proper government policy and administrative control over the middlemen, distributors and cold storage owners to rein in their dominance and tackle their unethical tricks.
- **WT3:** Increasing expenditure costs and decreasing profit (W3) is one of the major weaknesses of the existing farming system where the share of irrigation cost is not undeniable at all. The massive use of ground water during the dry post-monsoon season for irrigation purpose, leads to perceptible depletion of ground water level (T4) and also significant increment in the production expenditure. In such a situation, proper water harvesting strategies may be adopted to restore the rain water in monsoon season for the crisis periods. This will effectively mitigate the problems of excessive irrigation cost and prevent further exhaustion of ground water resources.

Respondents' opinions reveal that 95% of them has highly appreciated the WT2,

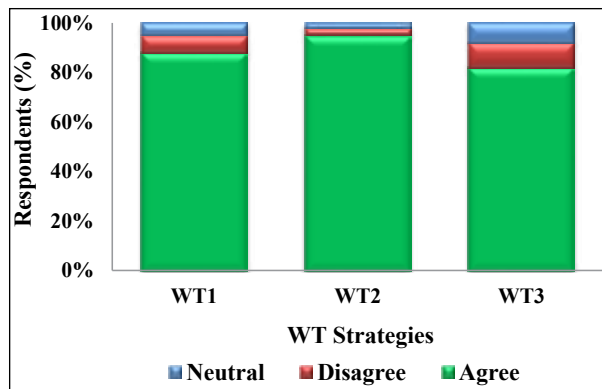


Fig 4: Perception of the respondents for WT Strategies

followed by WT1 (88%) and WT3 (82%) as indicated in Figure 4. Most of the respondents advocate in favor of implementing strong administrative control over the middlemen, distributors and cold storage owners to restrict the irregularities in markets. Controlling the artificial crisis and resulted abnormal pricing will certainly help the small and marginal farmers to get their deserved earning. It will encourage the cultivators to invest more in potato cultivation.

CONCLUSION

The present study has strived to ascertain the apt and effective strategies for future sustainability after examining the internal and external factors with the combined method of SWOT-AHP. The findings of SWOT group priority analysis has revealed that the strengths group ranked the first position with the group weight of 39.60% followed by opportunities (group weight 34.00%), weaknesses (group weight 15%) and threats (group weight 11.2%). The overall priority scores of combined SWOT-AHP have marked that unremitting demand of potato throughout the year (S5, 0.10) plays the role of the most dominant strength factors, whereas, increasing expenditure of production (W3, 0.04) is the major weakness within the existing potato cropping system of the area. Large scale employment generation for local as well as for

the migrant workforce (O6, 0.10) is the most prioritized opportunities, while oscillation in economic profitability (T2, 0.03) has threatened the system, particularly the sustainability of the livelihood of the small and marginal farmers. The small and marginal farmers of the area have been facing severe challenges in sustaining in potato cultivation due to the rapid and notable fluctuations in the economic profitability, which have pushed them to either shift to another crop or in extreme cases to give up agricultural practices. The strategic formulation by linking the most prioritized SO and WT factors have revealed that year long continuous demand of potato (S5) in domestic as well as commercial arena, leads to escalation in production and consequent large scale employment generations has become the most appreciated SO strategy (SO2, 90%) among the stakeholders of the area. While proper implementation of administrative control over the middlemen, distributors and cold storage owners to restrict the corruption and save the small and marginal farmer from deprivation (WT2, 95%) is the most prioritized alternative WT strategy. Thus it is necessary to draw the concern over internal strengths and weaknesses and focus on external opportunities and threats for better prospect, sustainable and effective growth of potato cultivation in the area under study.

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CONFLICT OF INTEREST

The authors confirm that this manuscript has no conflict of interest.

LITERATURE CITED

Alonso JA and Lamata M T (2006) Consistency in the analytic hierarchy process: a new approach.

- International journal of uncertainty, fuzziness and knowledge-based systems* **14(04)**: 445-459
- Borajee M and Yakchali S (2011) Using the AHP-ELECTRE III integrated method in a competitive profile matrix, Paper presented in International Conference on Financial Management and Economics, Hong Kong, China, 2-3 July 2011
- Chakraborty S and Chakma N (2020) Assessment of Development of Yuksom Gram Panchayat Unit in Sikkim using SWOT Model. *Space and Culture, India* **7(4)**: 133-142
- District Census Handbook Hugli, (2011) Director of Census Operations West Bengal.
- District Statistical Handbook Hooghly (1990-91 to 2013-14) Bureau of Applied Economics & Statistics. Department of Statistics & Programme Implementation, Government of West Bengal
- Ergu D, Kou G, Peng Y and Shi Y (2011) A simple method to improve the consistency ratio of the pair-wise comparison matrix in ANP. *European Journal of Operational Research* **213(1)**: 246-259
- Ghosh NP (2017) Problems and prospects of potato cultivation in Hugli District, West Bengal, Department of Geography, The University of Burdwan, Bardhaman, India
- Görener A, Toker K, and Ulucay K (2012) Application of combined SWOT and AHP: a case study for a manufacturing firm. *Procedia-social and behavioral sciences* **58**: 1525-1534
- Gürel E and Tat M (2017) SWOT analysis: a theoretical review. *Journal of International Social Research* **10(51)**: 994-1006
- Hatjal A and Mondal M (2015) Impact of Climate Change on the Production of Rice and Potato in Paschim Medinipur District, West Bengal. *IOSR Journal of Humanities and Social Science* **20(7)**: 79-85
- IMD (2008) Climate of West Bengal. National climate centre office of the additional director general of meteorology (Research) India Meteorological Department. Govt. of India.
- Kurttila M, Pesonen M, Kangas J and Kajanus M (2000) Utilizing the analytic hierarchy process (AHP) in SWOT analysis—a hybrid method and its application to a forest-certification case. *Forest policy and economics* **1(1)**: 41-52
- Lee S and Walsh P (2011) SWOT and AHP hybrid model for sport marketing outsourcing using a case of intercollegiate sport. *Sport management review* **14(4)**, 361-369
- Mookherjee D, Visaria S, Maitra P, Motta A, and Mitra, S. (2012). *Potato Traders in West Bengal: A Survey of Contractual Relations and Market Structure*. Working Paper, International Growth Centre.
- Oreski, D. (2012). Strategy development by using SWOT-AHP. *Tem Journal* **1(4)**: 283-291
- Roy A, Siddique G and Mandal MH (2019) A Study on the Productivity of Potato in Hugli District, West Bengal, India. *Journal of Geography, Environment and Earth Science International* **20(4)**: 1-14
- Sharma MJ, Moon I, and Bae H (2008) Analytic hierarchy process to assess and optimize distribution network. *Applied mathematics and computation* **202(1)**: 256-265
- Siddique G and Mukherjee N (2017) Transformation of agricultural land for urbanisation, infrastructural development and question of future food security: Cases from parts of Hugli district, West Bengal. *Space and Culture, India* **5(2)**: 47-68

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